nustem

Lessons learned from using the National Pupil Database in the evaluation of small-scale school interventions

This report presents a case study of a STEM education intervention that planned to use subject entry data tracking via National Pupil Database, and progression to University data via the Higher Education Statistics Agency within their impact evaluation. Ultimately this data analysis approach was not suitable or helpful for the project evaluation, and this report outlines the reasons for this. This report has been published with the intention of offering guidance and recommendations to others considering using these approaches to evaluate small-scale school interventions.

Outline of Intervention

Think Physics was founded in 2014 [changing its name to NUSTEM in 2017] as an education outreach team based at Northumbria University working to improve access and participation to physics and associated subjects, particularly for previously under-represented groups: girls and those from low SES backgrounds. The team worked with 15 secondary schools (and 15 primary schools) over an initial 3-year period (2014 – 2017) to provide sustained STEM engagement with a menu of activities, including school assemblies, in-class workshops, out of school workshops, STEM clubs, summer schools, involvement at careers evenings and events, and continuing professional development for staff. The project was funded, in part, by a HEFCE Catalyst grant.

Outline of Intended Evaluation Approaches

As agreed with the project funder it was intended to use analysis of NPD and HESA data for the long-term evaluation of the sustained intervention (See Appendix 1 for details of measures). The evaluation design proposed to use NPD data to monitor numbers of pupils taking A-Level Physics from partner schools, the number of female pupils taking A-Level Physics, and the number of pupils in areas of deprivation taking A-Level Physics (as identified by IDACI Score) and compare these figures against the regional and national average of numbers of pupils taking A-Level Physics. Additionally, the methodology proposed to utilise the subsequent two years HESA data (Course JACS codes) to track progression from A-Level Physics onto physics-related courses at University, again examining data by gender and low-participation background groupings. It was also intended that this data was compared with baseline figures (data from 2010 – 2014) before schools took part in the project to assess the success of the intervention in achieving the intended aim of improving Physics in the region, particularly for under-represented groups. In this area of the evaluation the aimed to explore:

1. whether Think Physics involvement in partner schools affects the uptake of Physics at A-Level and progression onto physics-related degrees at University, particularly for girls and those from low SES backgrounds;
2. how the numbers from partner schools compare to national and regional averages for the uptake of Physics at A-Level and progression, particularly for females and those from low SES backgrounds;
3. how the numbers from partner schools compare against similar schools in the North East region for the uptake Physics at A-Level and progression, particularly for females and those from low SES backgrounds.

The data analysis of the NPD and HESA data would be used alongside other complementary methods, such as primary data collection with target audiences, to assess the overall impacts of the sustained intervention. Access was granted to National Pupil Database and HESA data extracts and the analysis described above was undertaken. However, it became apparent that this data analysis approach was not helpful within the project's evaluation for the reasons described below.

Lessons Learned

1. When subject entry numbers are small, annual variability is great

NUSTEM worked with schools that wanted to improve the profile and uptake of physics in the school, mostly starting from a low number of pupils choosing A-level Physics each year. Prior to engagement with NUSTEM the rounded four-year rolling average (2010 – 2014) for entry of A-level Physics in the 15 partner schools was fewer than 10 pupils, with a range from 0 to 19 pupils.

During the time of the intervention (2015 – 2018), this variability continued with a similar average and range.

A requirement of working with data from the NPD is that published data must meet a minimum threshold level of 10. This process is to ensure that the data publication is not disclosive and to remove risks of potential identification of schools or individuals. The threshold level, however, makes it difficult for interventions that work with small groups or small entry subjects to report data from the analysis. The need to meet a threshold of 10 makes it challenging to report any change of the intervention in terms of impact on entry numbers, even when considering this across a broader level, such as a multi-school cohort level.

This problem of variability is compounded when examining the data by subgroups (in our case, gender and low SES background) as the numbers become even smaller. Across the 15 project schools, prior to their engagement with NUSTEM, the range of A-level Physics entry for female students was between 0 and 5 with large variability in individual schools. This variability continued throughout the intervention period. There was a similar pattern of entry for students from a low SES background. This means that these numbers cannot be reported because they are below the threshold of 10.

With such small numbers, A-level entry in a school subject can double if just one more student chooses the subject and halve if another student does not choose the subject the following year. This variability makes interpreting trends linked to the effects of an intervention problematic, particularly when a school has low numbers of pupils taking that A-level subject. Annual changes can easily be attributed by cohort groups, teachers or teaching style, or other extra-curricular activities. Therefore, use of A-level and degree progression is not a suitable measure for evaluating the effect of an intervention in a single school, or a small number of schools, where the overall number of pupils studying that subject is low.

2. NPD data structure and methodology changes over time

The National Pupil Database collects data on pupils from schools in an annual school census. However, the methodology of what data are collected and how they are classified can change depending on government policy and school accountability measures[1]. This means that data fields and record structures can take different formats from one year to the next. For example, under the Academy programme a school may close and a successor institution immediately open on the same site with the same pupils. However, the school will have a new data code within the NPD, and it would look like the associated pupils had all moved school. Similarly, in 2016 and 2017 major changes were made to the structure of the Key Stage 5 (A-level and equivalent) which meant that it was no longer straightforward to obtain A-level results aggregated by region, although individual school and national averages could still be obtained with relative ease.

Reliable reporting of NPD data requires a thorough understanding of the structure, methodologies, and classifications of the data sets and an awareness and understanding of annual changes. This is probably most effectively undertaken by researchers who work with the National Pupil Database on a regular basis.

[1] 'Data Resource: The National Pupil Database (NPD)', IJPDS at https://ijpds.org/article/view/1101

3. Making comparisons of intervention data with national data is challenging due to different methodologies

One option NUSTEM researchers explored was to compare school level data with national and regional level data on Physics entry publicly available on websites such as OfQual[2], Joint Council for Qualifications Council[3] (JCQ), and SEEdash[4]. However, we found differences in the reported numbers for Physics entry nationally across the different websites, and also when compared with Physics entry data extracted from the NPD. This would suggest that different methodologies or criteria for inclusion were applied for the calculations in each case. Comparing intervention level data with data extracted from other datasets is therefore challenging due to the use of different methodologies and would again require a thorough understanding of other datasets to allow for successful matching and valid comparison.

Regional level data on Physics entry was publicly available on the SEEdash website (2002 – 2017) and on the OfQual website from (2017 – 2021). However, matching these two datasets using 2017 data produced differences in numbers for the same nominal geographical region. Additionally, there are no publicly available data where regional entry numbers can be explored by other variables such as gender or low SES backgrounds. Again, this is likely to be due to reduce the risks of disclosure of schools or individuals. For interventions considering outcomes for particular groups, then utilising publicly available data sets may not provide enough detail.

4. Final publication of exam results in NPD is time-delayed

GCSE and A-level exam results are published by JCQ in August each year. However, in order to allow for examination processes such as appeals the NPD is updated three times: in November the same year (unamended data), January (amended data) and April (final data) the following year. Thus, there is at least an 8-month delay between students receiving their exam results and those results being available to external researchers via NPD. Furthermore, if entry to degree subjects is part of the expected impact of an intervention, then tracking pupils using the HESA database would necessitate another year (or more) before the impact could be seen.

For interventions working on shorter time scales this delay limits the utility of the NPD and HESA data as an evaluation mechanism.

Recommendations

Recommendations for Interventions

- Assess in advance the likely numbers of your intervention and whether they will be large enough for the variability to be minimised, and for impacts to be noticeable within the threshold levels.
- Consider whether you would be able to apply for, gain access to and analysis data within your reporting deadlines.
- Consider working with companies using NPD data on a regular basis to undertake analysis on your behalf.
- Investigate other metrics for your interventions. Good examples include STFC Public Engagement Evaluation Framework[5] and Ogden Trust Evaluation Toolkit[6].

[2] 'The Office of Qualifications and Examinations Regulation (Ofqual)' at https://www.gov.uk/government/organisations/ofqual
[3] 'Joint Council for Qualifications' at https://www.jcq.org.uk/.
[4] 'Science and Engineering in Education' at https://seedash.iop.org/.
[5] 'STFC Public Engagement Evaluation Framework' at https://stfc.ukri.org/files/corporate-publications/public-engagement-evaluation-framework/
[6] 'Ogden Trust Capturing Impact: an informal science education evaluation toolkit' at https://www.ogdentrust.com/assets/general/Evaluation-Toolkit-FINAL_March-2021.pdf

Recommendation for Funding Bodies

- Consider other acceptable metrics for the evaluation of interventions where there are likely to be small numbers of participants, or where the baseline data is likely to be very variable.

Recommendation for Data Controllers

- Offer early advice and guidance for those considering applying for access to datasets about the suitability of the data for their proposed research.
- Signpost the NPD user group to researchers for further support and training.

This report was compiled by the NUSTEM Group at Northumbria University in February 2022.

This work was produced using statistical data from ONS. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

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Appendix 1

Key Performance Indicators

Original key performance indicators for the STEM Education intervention related to uptake of A-level physics and physics-related degrees.

Success Criteria	Measure
Increased (or maintained) number of school pupils studying A-level physics in partner schools	in 2017/18 achieve 10% annual increase relative to regional and national averages
Increased (or maintained) number of female school pupils studying A-level physics in partner schools	In 2017/2018 achieve 10% annual increase relative to regional and national averages.
Increased (or maintained) numbers of children from low participation neighbourhoods choosing to study physics and related undergraduate programmes across the UK.	In 2017/2018 achieve 10% annual increase relative to regional and national averages
Increased (or maintained) numbers of school pupils from partner schools progressing to study physics and related undergraduate programmes across the UK.	In 2017/2018 achieve 10% annual increase relative to regional and national averages.
Increased (or maintained) numbers of female school pupils from partner schools progressing to study physics and related undergraduate programmes across the UK.	In 2017/2018 achieve 10% annual increase relative to regional and national averages.
Increased (or maintained) numbers of school pupils from low participation neighbourhoods progressing to study physics and related undergraduate programmes across the UK.	In 2017/2018 achieve 10% annual increase relative to regional and national averages.

For secondary school interactions, in-school data was collected in 2015, 2017 and 2019.

The 2015 data were used to provide a baseline data for science capital measures.

For the Key Performance Indicators given above, NPD data for yearly A-level entries between 2010 and 2014 were used to provide a baseline measurement of average A-level physics entry for each school and for all partner schools. A baseline measure for progression to physics and physics-related degrees was obtained from matched HESA data.