Evaluation Report

Taiscéalaí Programme - 2024

Dó Cent Consulting

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Introduction

Background

The Taiscéalaí project came about through a collaboration between two manufacturing research centres: Irish Manufacturing Research (IMR) and I-Form, Creative Spark Enterprise FabLab and Inspire3D. The program is funded through Research Irelands Discover Programme and is in its second iteration.

The word 'Taiscéalaí' is an Irish word that means Adventurer, so that the main audiences would find themselves responding to an exciting challenge using the latest in 3D printing technology and processes.

The objective of this project was to co-create, develop and deliver curriculum enhancing resources that would impact two main audiences; primary school students and primary school teachers. Meeting this objective formed a complex challenge in that the content was required to both align with and significantly enhance the Irish primary school curriculum.

Context

3D printing (known in the industry as additive manufacturing) is a key enabling technology of 'Industry 4.0' – a term used to signify the new era of industrial production, encompassing advanced technologies such as artificial intelligence, machine learning, robotics, and the Internet of Things.

The Taiscéalaí program recognises that teachers are key influencers of the next generation, and aims to provide them with access to information and technology around the newest areas of science, technology, engineering, and mathematics (STEM) and manufacturing.

2024 Programme Outline

The science outreach programme commenced with a series of Teacher Co-Creation Workshops aimed at fostering collaboration and innovation in teaching methods. The first workshop took place in-person at the IMR in Mullingar on the 2nd of April, with seven teachers in attendance. This was followed by an online session on the 20th of May, which utilized a Miro board for interactive brainstorming and was attended by five teachers. The final workshop in this series was conducted online on the 10th of September, with three teachers participating.

In addition to these workshops, the programme included a comprehensive 3D printing training course designed for primary teachers and youth educators. This two-day training was held on the 1st and 2nd of July at the IMR in Mullingar and saw the

participation of 23 individuals. The training provided attendees with hands-on experience and knowledge in 3D printing technology.

Building on the insights gained from the workshops, the programme developed new teaching resources. Version 2.0 of the Teacher Guide, which includes detailed lesson plans, and an accompanying Student Workbook were created. These resources were refined based on feedback from the co-creation workshops and are currently with the design company, with the final versions scheduled for release in March 2025.

The programme also launched a **3D Printing Challenge Competition** with a focus on sustainability. The competition details were circulated to teachers in early September, and entries were accepted until the 16th of December. A total of 14 entries from four schools were received and evaluated by a panel of I-Form researchers. The winners were notified on the 20th of December, and prizes were distributed to schools in early 2025.

The culmination of the programme was marked by the End of Year Celebration Event held on the 10th of December at the Mullingar Park Hotel. This event was attended by four schools, with approximately 160 pupils present. During the event, pupils had the opportunity to present their competition projects, tour the IMR facilities, and participate in an awards ceremony, celebrating their achievements and creativity.

Objectives

The objective of this report is to evaluate the impacts of the iterative impact of the Taiscéalaí project in its second year.

The evaluation of the project centred on understanding more about its impact across the implementation and the overall experience of its stakeholders. Qualitative and quantitative data collection mechanisms were put in place for key audiences at the start of the project in order to achieve this goal.

Methods

The programme consisted of two interdependent strands:

- Teacher Co-creation and training , and
- Pupil engagement in the challenge competition

Data Collection

Both strands were used to capture data on the two main stakeholder groups (teachers and pupils).

Teacher Co-Creation and Training Data

Teachers were involved in participatory co-creation workshops and subsequently trained in all aspects of the project resources.

Qualitative and quantitative data were collected as follows:

- Qualitative
  - Email testimonials (n = 3)
- Quantitative
  - Co-creation workshop feedback (n=8)
  - Pre and post challenge surveys (n=19, n=15)

Pupil Engagement Data

Once teachers were fully equipped to support students, they went on to teach and support students through the 3D Printing Challenge and its competition.

Data was collected from both pupils and teachers in terms of pupil engagement with the challenge competition.

Quantitative data were collected as follows:

- Post challenge teacher surveys (n=10)
- Post challenge pupil surveys (n=160)

Data Analysis

This section details the characteristics of the data and the data transformation and subsequent analysis methods.

Characteristics

The structure of the surveys created some comparative data for the evaluation within the sample of teachers surveyed. Some questions were measured categorical variables and some used intervals in measuring perception of several aspects of each strand.

Data Analysis

Comparable data was amalgamated and analysed using appropriate visualisations per variable in the teacher respondent sample. Due to low respondent numbers in the teacher sample, despite sample consistency, the use of inferential statistics was not recommended.

The pupil sample was large enough for statistical inference, however open questions led to many differing qualitative self-reported responses. Descriptive analysis was therefore used.

Findings

In order to provide granularity around each stakeholder and strand, the findings are presented per programmatic strand below; firstly teacher engagement outcomes and secondly pupil engagement outcomes.

Teacher Engagement

Teacher engagement comprised co-creation workshops with feedback and training sessions with pre and post training surveys. Data consisted of online surveys and open approach email testimonial feedback.

Qualitative and quantitative data were collected as follows:

- Qualitative
    - Email testimonials (n = 3)
- Quantitative
    - Co-creation workshop feedback (n=8)
    - Pre and post training surveys (n=19, n=15)

Co-Creation Workshop Survey

Teachers who participated in the co-creation workshop were asked:

> *Do you think that 3D printing is a useful tool for STEAM learning in primary school settings?*
>
> *At this point in time, would you encourage your students to pursue a career in the manufacturing industry?*
>
> *Do you think that 3D printing can grow childrens' understanding of STEAM as fun, interesting and accessible, and with the opportunity to lead to exciting careers?*

All respondents (n=8) answered 'yes' representing a motivation and enthusiasm on the topic.

Participants were further questioned on how the content / structure of the co-creation workshop could be improved. There were a variety of individualised responses including:

> *Ability to visualise and use the 3D printer within the session*
>
> *Setting up a group to collaborate and chat outside the session*
>
> *Being able to welcome new teachers and those who already had experience.*

Overall the content was very well received.

Pre and Post Training Surveys

Teachers were then provided with training that would ensure they had

- Learned about the different components that make up a 3D printer
- Learned how to calibrate, troubleshoot, maintain and be safe with a 3D printer
- Gained hands-on experience using design software and printing in 3D
- Explored 3D design lesson plans designed for primary education settings
- Been invited to explore curriculum links for 3D printing

Pre-training Survey

The pre-training survey consisted of fifteen (15) questions aimed at understanding how the teachers were prepared for the training and managing their expectations.

Statement	**Average Rating**
Experience with 3D Printing	1.5
Confidence with Educational Technology	4.5
Confidence with new technology in class	5

Many teachers cited iPads and tablets in the range of technology used in the classroom.

Post-training Survey

The post training survey detailed that satisfaction with the training was very high. The average rating was 9.5 out of 10.

Low levels of requirement for technical support, lesson plans, further training and ideas for the classroom were reported. This is indicative that participants gained exactly what they required from the course and is to be commended.

Comparable data – pre and post training

In the pre and post training surveys we observe several questions with comparable pre and post measurements.

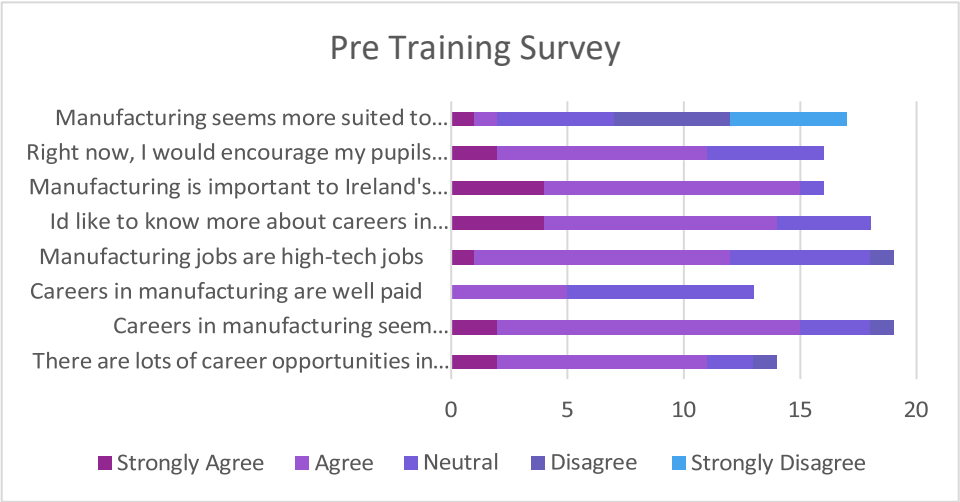
Confidence in using 3D printing was measured before and after the training.

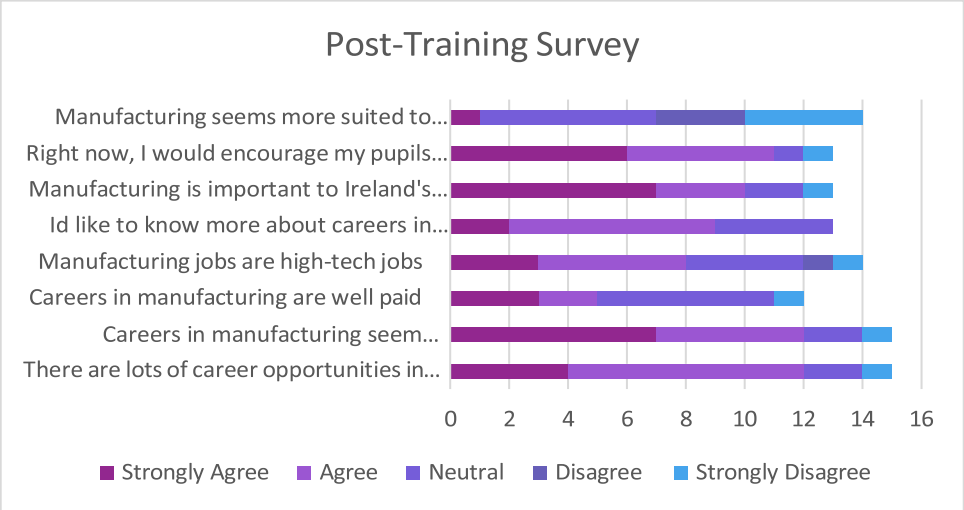
The pre-training average rating out of 10 was only 2, whereas after the training the average was 7.

These were recorded on a five-point categorical scale from Strongly Disagree to Strongly Agree.

A table to directly compare percentages of those selecting each category pre and post training was developed. The results are reported below in tabular form and overleaf in visual form.

	There are lots of career opportunities in manufacturing right now	Careers in manufacturing seem interesting	Careers in manufacturing are well paid	Manufacturing jobs are high-tech jobs	I'd like to know more about careers in manufacturing	Manufacturing is important to Ireland's economy	Right now, I would encourage my pupils to consider careers in manufacturing	Manufacturing seems more suited to boys than girls
Strongly Agree - Post	**21%**	37%	16%	16%	11%	**37%**	**32%**	5%
Strongly Agree - Pre	**19%**	31%	13%	6%	13%	**25%**	**19%**	6%
Agree - Post	**42%**	**26%**	11%	**26%**	**37%**	16%	**26%**	0%
Agree - Pre	**31%**	**13%**	6%	**13%**	**19%**	6%	**19%**	0%
Neutral - Post	11%	11%	**32%**	**21%**	21%	11%	5%	**32%**
Neutral - Pre	0%	6%	**6%**	**6%**	13%	6%	0%	**19%**
Disagree - Post	0%	0%	0%	5%	0%	0%	0%	**16%**
Disagree - Pre	0%	0%	0%	6%	0%	0%	0%	**0%**
Strongly Disagree - Post	5%	5%	5%	5%	0%	5%	5%	**21%**
Strongly Disagree - Pre	6%	6%	6%	6%	0%	6%	6%	**13%**





As demonstrated, many categories showed an increase in desirable responses from within the sample. Whilst owing to the sample size, this is a descriptive summary, the positive increase did occur across all measures which is significant.

Email testimonials supported this impact with one teacher saying:

> *"As teachers, it is wonderful for us to see a program like this drawing out skills and talents which we may not otherwise notice such as group negotiation and presentation skills."*

Pupil Engagement

Pupil engagement comprised preparation by teachers for the 3D Printing Challenge Competition and the 3D Printing Challenge Competition day.

Quantitative data were collected as follows:

- Post challenge teacher surveys (n=10)
- Post challenge pupil surveys (n=160)

Post Challenge Pupil Survey

The ratio gender in the pupil population was 47% female and 53% male.

Engineers Ireland report that Ireland are, unfortunately, third last within OECD countries for gender balance. The fact that such equity is demonstrated at primary school is to be lauded, yet it does beg the question given only 16% of engineering graduates are female in Ireland, that this issue becomes apparent at a later stage of education.

Pupils were asked to rate the overall experience and the average rating was 4.3 out of 5 and 96% of all pupils had fun.

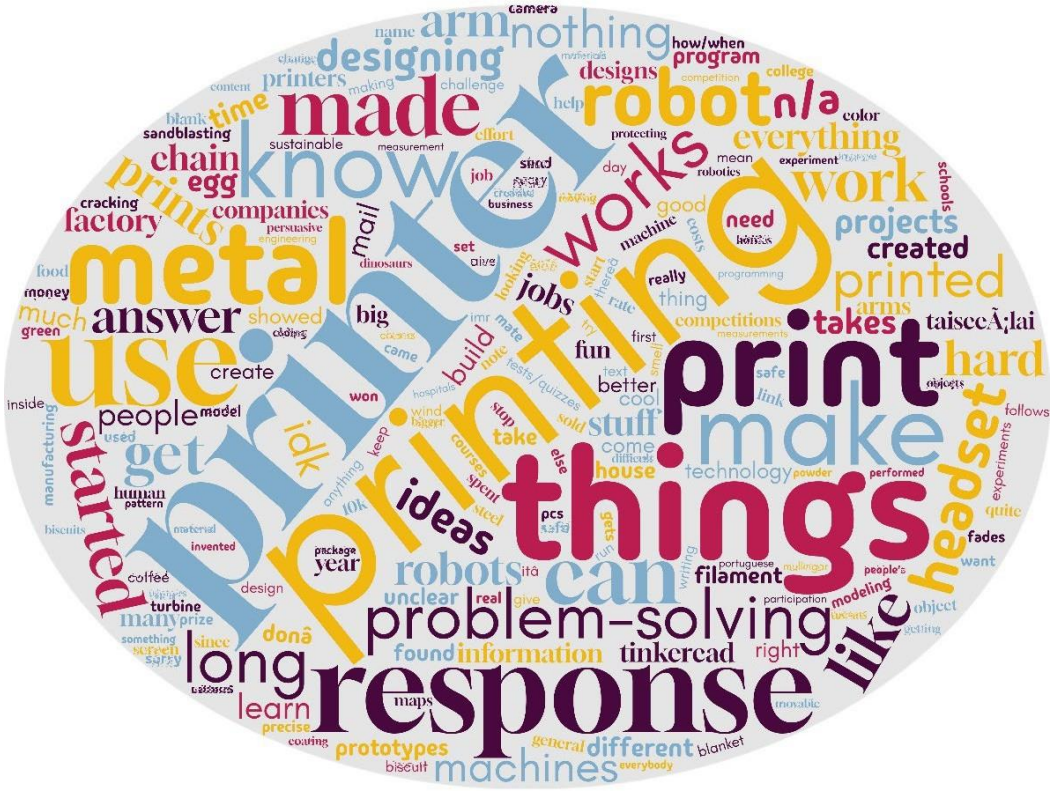
There is little doubt that the programme represented a highly engaging experience for the participants.

Career choices were impacted in some children. It is a very early stage of life to judge decisions on careers, however a strong 20% of children identified STEM careers. This was in an open question, so did not introduce bias by presenting selections.

Currently in Ireland, only 1 in 10 people work in STEM professions, so this is a very healthy figure.

30% of pupils said that the programme influenced their choice of career which is highly impactful.

In the children's own words, here is what they found the most engaging about the programme:



Post Challenge Teacher Survey

Teachers were asked to reflect on the challenge competition in a survey that requested ratings and information about key metrics. There were 10 respondents. They reported that the programme positively impacted:

- pupil and teachers' digital skills
- pupil and teachers' sustainability awareness

Furthermore, teachers outlined some key challenges the pupils experienced such as:

- Having to redesign again and again
- Coming up with an idea, having the correct measurements
- The language needed to convey their ideas accurately to somebody who has not been part of the creative process
- Working collaboratively at times

However, these issues are to be expected in a young group.

Summary and Recommendations

Summary

In summary, both strands of the Taiscéalaí 2024 programme have been impactful and reached the desired outcome of influencing students perceptions of STEM careers more specifically relating to advanced manufacturing.

The engagement with teachers at an early stage in order to develop materials and training suitable and practical for a school setting has been highly successful in terms of its reception by teachers and the resultant influence that this has achieved for pupils.

Pupils themselves were articulate, clear and positive in their feedback on the 3D Printing Challenge. Their responses, as demonstrated in the findings section showed that there was a high level of appreciation, enjoyment and impact from their engagement this year.

Recommendations

The programme per-se has represented a significant success. In terms of evaluation recommendations moving forward, the Taiscéalaí team would be well placed to provide more structure and comparability to the research instrument in the form of consistent questions. This would enhance the ability of future evaluations to build on the methods and compare data over time.

Notably, the teacher training evidenced a highly effective course with impactful data that demonstrated depth and lasting achievement of goals in this area. In addition, the programme did influence children's career choices as reported in the data.

Care should be taken to note the equity of gender represented at primary level – this falls to only 16% of graduates. The consortium has a lot to do in bringing this forward to later stages of education but it is clear that such success should be furthered.