

The effects on wellbeing of participating in digital fabrication sessions

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Abstract

This paper explores the role of digital fabrication or digital craft participation in improving wellbeing, particularly for those from disadvantaged groups. CNC Craft, a small company based in the South-West of England, collaborated with the University of Exeter to explore how to quantify the wellbeing gains of participating in digital fabrication/craft sessions.

A feeling star was used to capture participant responses measuring six key attributes; happiness, hopefulness, skilfulness, confidence, health and inclusion. Analysis showed that the average scores for each of the six attributes increased, with feelings of skilfulness and confidence increasing most. The results indicate that digital fabrication/craft sessions can have a positive impact on wellbeing, including for those with low levels of computer confidence.

Although a small study, the results indicate the wider social value that can be gained from creative digital skills training. The work also demonstrates the value that small businesses can gain from working collaboratively with Universities. The paper goes on to propose the adoption of similar evaluation techniques to build an international evidence base, and support other FabLabs and Maker Spaces to develop these opportunities.

Keywords

Digital fabrication, Maker Space, wellbeing, evaluation

1

CNC Craft

CNC Craft is a small digital workshop in Cornwall in the South-West of England specialising in furniture making and contract woodwork. Established in 2005 as a traditional joinery shop promoting a greener manufacturing environment in Cornwall, over the last 15 years the company has gradually moved into the digital sector using predominantly self-made tools. These include a large CNC router, a laser cutter, 3D printers and an embroidery machine.

In 2015, the company began free monthly Maker Space sessions for people in the local community who wanted to learn how to use and understand the potential of digital tools, and in the process exercise their creativity making small personal projects.

The original motivation for setting up the Maker Space came from a strong interest in environmental, ethical and distributive design. In the same way that the organic food movement promotes greener agriculture, the Maker Space aimed to raise awareness and interest in the potential for local production. Maker Spaces were held as regular activities under the auspices of a local Transition Group: 'Sustainable St Agnes', and initially used the Transition Group mailing list to promote the Maker Space. Two, three-hour sessions were held every 2nd Saturday of the month for anybody in the local community who was interested in learning about digital crafts, or who had a specific maker project they wanted to undertake (see figure 1).



Figure 1: Some of the Maker Space participants and their projects.

With a background in adult education and training, Aaron Moore, CNC Craft's founder and owner, also developed a series of training programmes designed to enable people with any level of IT skill, from complete beginner to advanced user, to design and make a range of items. Learning the basics on open-source software, participants could continue to access and develop their skills from home, if they wished. They could even return to the workshop, hire the equipment, and produce more items.

At each Maker Space, sessions begin with each participant making a small name tag using Inkscape and the laser cutter, instilling the idea that the digital craft process has to involve a computer aided design file that a numerically controlled machine can interpret. After making the name tag, participants continued with their own projects under the guidance of the Facilitator. These projects could involve using the router or the 3D printer as well as the laser cutter and, in some cases other software such as LibreCAD, Blender or FreeCAD can be used to develop the design, where Inkscape is not appropriate.

Feedback from participants indicated a demand for more in depth, focused training leading, in 2017, to CNC Craft expanding its training activities and facilities. The addition of the 'Digital Training Hub' provided a bespoke training facility equipped with enough laptops, a laser cutter, two 3D printers and a large digital display screen to support the training activity. The industrial CNC router remained in the main workshop but was still accessible for training. The Hub was used to continue running the Maker Spaces as well as a series of newly developed training courses providing more in depth training on single technologies, such as:

- 3-day CNC router course
- 1-day Laser cutting course
- 1 day 3D printing course

These courses are offered on a commercial basis.

Over 160 people have attended the Maker Space sessions. In 2018, the interest and impact of the sessions led to the company exploring the further development of a training arm. They wanted to explore how training could not only build skills but also explore the role digital craft skills could play in improving wellbeing and employability for those furthest from the workplace. A series of training programmes were developed, and discussions were held with several organisations working with disadvantaged communities. It quickly became clear that in order to attract participants and funding for this training activity, the company needed evidence of its value.

1.1 Context

Cornwall is renowned for its natural beauty and dramatic coastline. However, this 'picture postcard' view masks the challenges faced by many communities: the low-paid and insecure work associated with the tourism sector, poor quality housing, low skills and poor health outcomes associated with economically deprived areas. Some of the most disadvantaged communities in the United Kingdom are in Cornwall (Cornwall Council, 2019). The potential to develop training programmes that could help to support individuals to improve both their mental health and wellbeing, and increase their employment potential, seemed an obvious fit for the Maker Space and CNC Craft.

2 The Wellbeing Course

The initial idea for the wellbeing focus came from the experience of a father and son who participated in a Maker Space. Arriving in obvious conflict, after working on a collaborative project, tensions eased, and both were clearly much happier and more relaxed in each other's company by the end of the session. This along with the positive feedback that the Maker sessions engendered, prompted the thought that if people enjoyed the sessions perhaps there was an improvement in wellbeing that could be used to support people facing other challenges. Quantifying this benefit would also add to the evidence supporting initiatives such as the Maker Space. In addition, as a digital based activity, developing computer skills in an indirect, non-judgemental environment was also a potential way to support those with low IT skills to gain confidence, and support wider employment aspirations.

Subsequently, CNC Craft went on to create specific wellbeing sessions following the 3-hour process successfully developed for the Marker Space. The premise behind these, was to support individuals to build their confidence in using IT, sharing the challenge in a small, supportive group environment, and resulting in the production of a small item of the participants own choosing, such as a jewellery box, clock face, etc. These objects provided a record of their achievement that could be taken home. Digital craft processes make the production process very accessible, as it is relatively easy to make complex and intricate products after some very basic CAD/CAM training.

Exploring the evidence, on craft and wellbeing, it quickly became clear that very little research existed into the specific value of digital crafts in relation to wellbeing, although many studies have shown the positive value of creative craft sessions on mental health and wellbeing. The Crafts Council UK has drawn together a number of studies that together demonstrated that traditional crafts can alleviate the symptoms of anxiety, depression, loneliness and even dementia (Craft Council, 2020). Similarly, The Men's Shed movement report the health benefits to their members of practical shed activities include 'reduce isolation and feelings of loneliness, they allow men to deal with mental health challenges' (UK Men's Sheds Association, 2021). CNC Craft recognised that they needed support to find and develop evidence related to the impact of their digital fabrication courses.

3 University of Exeter collaboration

The University of Exeter's Truro Campus is located near to CNC Craft, and was the obvious place to start looking for support. In particular, the Smartline Project, a European Regional Development Fund supported project, which explores how digital technology can support health and wellbeing (University of Exeter, 2019), is based on this campus. The project works with small and medium enterprises (SMEs), to support research, development and innovation (RD&I) in eHealth and eWellbeing to improve the economic performance of the region.

Through the innovative Smartline In-Residence programme, which funds small businesses and University researchers to work together on collaborative RD&I projects, CNC Craft and Smartline researchers

explored how they could quantify the wellbeing gains for participants taking part in digital fabrication courses.

The In-Residence also funded a number of training sessions, offered through organisations working with people with mental health problems, low skills or experiencing long term unemployment, to pilot the approach and collect initial data. In addition, to build the understanding and knowledge within the company, CNC Craft also attended a Smartline delivered training course on evaluation techniques for SMEs, to ensure the required knowledge to continue to develop the methodology was embedded in the company.

3.1 Literature Review

One initial question for the In-Residence was to identify wellbeing related outcomes that were relevant to CNC Craft's courses. The approach taken to do this was firstly to explore the existing evidence base regarding similar interventions and then select the outcomes that were appropriate to the courses and feasible to collect. Subsequently a search was undertaken by the University of Exeter researchers using terms relevant to CNC Craft. The following major bibliographic databases were searched in April 2019: MEDLINE, PsycINFO, Embase, Health Management Information Consortium, Social Policy and Practice, Global Health. These searches identified 231 papers and following duplicate removal and removal of irrelevant papers, 73 papers from around the globe remained.

The majority (73%) of the relevant studies were related to Men's Shed interventions, with a further 11% related to FabLab initiatives. Older men's physical and social health was the focus of the majority of papers. With a smaller number of papers focusing on those with disabilities, intellectual disabilities, with children and intergenerational mentoring coming through as newer areas. Across the studies two routes to improved wellbeing were consistently described:

1. Engagement in purposeful activity including learning and skills acquisition
2. Engagement in social activity

Both qualitative and quantitative studies were identified. Age Scotland (2017) and Hlambelo (2018) highlighted the value of collecting qualitative stories alongside quantitative data to encourage more people to participate and influence a range of stakeholders. The literature review confirmed CNC Craft's findings that there was very little research focused specifically on the benefits of digital fabrication training.

3.2 Pilot course evaluation

From the outset it was obvious that any evaluation study would have to rely on the subjective feelings and judgements of those who took part. It was also recognised that any method developed needed to take into account the vulnerable nature of many of the people coming to these courses, and the need for the data collection to be quick and unobtrusive. Presenting the evaluation questions in an attractive and easy to understand visual manner was vital to address these issues, especially when the participants are able to plot their responses on the axis it can help them, as well as the organisers to recognise where change has taken place. These forms of evaluations often produce webs or stars. Based on the findings of the literature review and the need to keep the evaluation brief, it was agreed to ask the participants about six outcomes. Did they feel; happy, hopeful, skilful, confident, included and healthy (Figure). These attributes were selected to reflect both the participant's experience of purposeful (confident, skilful) and social (included, happy) activity. Participants were asked to rate their agreement with each of the six statements from: 1 - strongly disagree to 5 - strongly agree.

Participants were asked to score their feelings before and after each training session. Two separate questionnaires were designed (see Appendix One), both incorporating the same 'feeling star'. The first, a baseline survey, was designed for use at the beginning of the training session or sessions and included two 5-point Likert scale scored text questions: 'Do you enjoy using computers?' and 'Do you enjoy making things?' These were included to gain an understanding of the participants' computer literacy and whether they enjoyed creative activities as context to their responses. The second questionnaire was used at the end of the session, included three further Likert response questions asking about how

enjoyable and easy the session had been. Participants were asked if they would want to return and make something else. Finally, to gather stories 'Do you have any comments?' was asked as an open-ended question.

Through working with the University of Exeter CNC Craft also ensured that the evaluation would be ethical and undertaken in compliance with General Data Protection Regulations (GOV.UK, 2018), collecting informed consent from participants.

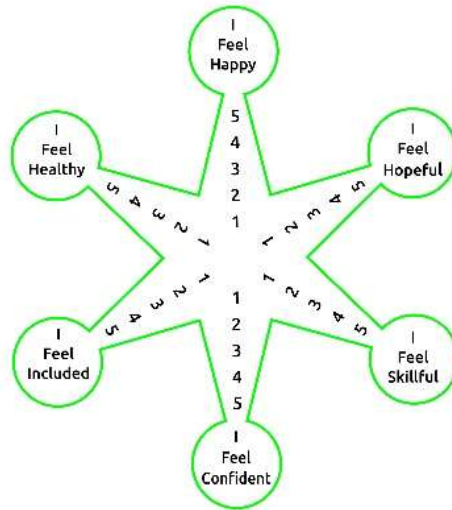


Figure 2: The feeling star developed to assess the impact of the CNC Craft Wellbeing course.

For the pilot, a number of community focused organisations with diverse objectives and target groups were contacted such as the Inspiring Women's Network, Tavistock Scrap Store and Trelya Community Centre.

Across the six pilot sessions funded by the Smartline Project, 17 people completed both the before and after evaluation forms. All of the participants surveyed enjoyed making things (responding to the question 'Do you enjoy making things?' with a 4, or 5, out of 5) before participating in a CNC Craft training session, but a third did not enjoy working with computers (responding to the question 'Do you enjoy using computers?' with a 1, 2, or 3, out of 5). Before the training session participants rated their feelings of skilfulness (average 3.06) and confidence (average 3.18) lowest out of the six attributes, and happiness (average 3.94) and inclusion (average 3.76) highest. The average scores for each of the six attributes increased during the CNC Craft training session, with feelings of skilfulness and confidence increasing most. We need to be a little careful about interpreting this, as these were the lowest scores before the training session, so there was most potential for them to increase, however, the results give us a sense that the CNC Craft Wellbeing course is having positive impacts on participants wellbeing. Before the CNC Craft training sessions only 24% rated their feeling of skilfulness as 4 or 5 out of 5, and 35% for confidence, where these increased to 71% and 76% after the training session. Even, the percentage of participants rating their sense of hopefulness as a 4 or 5 out of 5 rose from 53% to 100%.

All the participants surveyed rated their enjoyment of the training as a 4 or 5 out of 5, with people finding the equipment easier to use than the software. Everyone wanted to return and make something else. (Figure 3 shows these sessions in action.) Comparing those participants who rated their enjoyment of using computers as low (1 or 2 out of 5) compared to those who rated it high (4 or 5 out of 5) before the sessions, there was some evidence of lower feelings of confidence and inclusion before the training session, which did not persist to the end of the session. There was no difference in the ratings of enjoyment of the training sessions, or ease of use of the software and equipment between these groups. Although, the number of participants was small, this suggests that CNC Craft training sessions are accessible for those who are more or less confident with computers. The three words which were most commonly used by participants in response to the 'additional comments' question were: 'interesting', 'enjoyed' and 'fantastic'!



Figure 3: Participants during training sessions

3.3 Ongoing course evaluation

Following these pilot sessions participants at the wellbeing courses, regular Maker Space sessions, and the longer formal training courses, have continued to be invited to take part in the evaluation activity. Participants in the Marker Space and formal training courses were generally taking part out of an interest in learning more about digital manufacturing or had a personal project they wished to complete. Between June 2019 and the first COVID-19 lockdown in March 2020 a further 45 complete responses were received. The largest increases in score are seen in feelings of confidence and skilfulness, and of the 45 participants:

- 59% increased their happiness score
- 52% increased their hopefulness score
- 64% increased their skilfulness score
- 67% increased their confidence score
- 55% increased their included score
- 41% increased their health score

The changes in scores all appear to be statistically significant, but the sample is small.

Figure 4 shows the improvements across all six outcomes. The largest increases are now in feelings of confidence and skilfulness which are consistent with the findings of the literature review. The smallest increase is in feelings of health which are less likely to change over the short period of a 3-hour session. Around 20% of these participants were less confident with computers and almost all of them reported enjoying making things. Forty four of the participants wanted to return to make something else.

Anecdotal evidence from participants across the Maker Space and pilot wellbeing course suggest that participating in sessions can go on to make significant positive change, with one participant crediting their success in securing a job on the skills and confidence developed as a result of their participation.

4 Strengths and limitations of the evaluation

In the absence of a control group who do not participate in the Wellbeing course, we cannot attribute these changes the CNC Craft Wellbeing course. However, identifying similar participants makes undertaking a controlled evaluation difficult within a small enterprise. The evaluation forms have proven easy and quick to complete allowing CNC Craft to collect quantitative and qualitative data to help evidence their impact. The findings are consistent with the existing evidence on similar interventions like Men's Shed and FabLab.

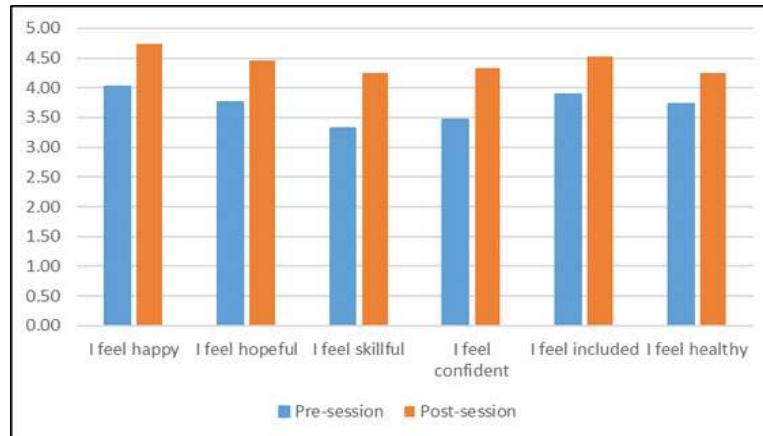


Figure 4: Wellbeing improvements in participants across six outcomes

5 Conclusions and Recommendations

Although a small study, that will need further validation, our findings indicate the wider social value that can be gained from creative digital skills training. In addition to further strengthening the position of Maker Space/FabLabs as a valuable resource for the local community, wellbeing courses could provide an important additional income stream for these facilities. In the UK, considerable investment is being made into social prescribing, also sometimes known as community referral, a means of enabling health professionals to refer people to a range of local, non-clinical services (Buck and Ewbank, 2020). Many different activities are offered to individuals through this route, but to date, there is little evidence of digital craft skills being included in the portfolio.

To build the evidence to support such activities, Maker Spaces and FabLabs could consider adopting a common evaluation framework, to collect data on a larger, wider scale that could be used to establish beyond doubt the role that digital craft skills can play in the health and wellbeing of participants. Aaron Moore of CNC Craft would welcome interest in exploring this idea from other groups and organisations.

A key element of the success of this work was the collaboration between CNC Craft and the researchers at the University of Exeter, funded by the Smartline Project. The In-Residence Programme provided a means by which a small company could easily and effectively access support from the academic community. The authors would like to take this opportunity to encourage and recommend similar mechanisms that simplify and facilitate SMEs gaining access to their local academic experts.

Prior to the pandemic, CNC Craft had gone on to attract funding for its digital skills courses, but this work was interrupted by the COVID-19 pandemic. As we start to emerge from the restrictions, CNC Craft plans to relaunch this initiative.

Acknowledgements

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APPENDIX ONE

Base line questionnaire

Evaluation Form for CNC Craft Digital Training Hub

Please fill this page in before the session

Name.....

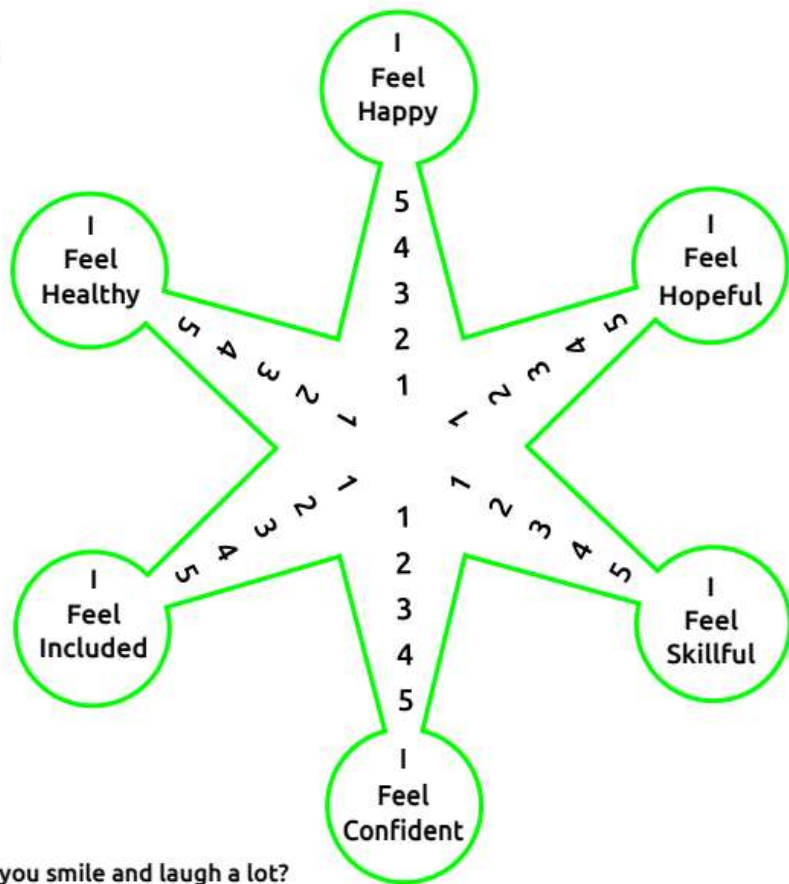
Date.....

Do you enjoy using computers? ☹️ ☹️ ☹️ 😊 😊

Do you enjoy making things? ☹️ ☹️ ☹️ 😊 😊

Wellbeing Star

- ☹️ = 1
- ☹️ = 2
- ☹️ = 3
- 😊 = 4
- 😊 = 5



Key:

I feel happy.....Do you smile and laugh a lot?

I feel healthy...Do you enjoy doing physical things like sports, games, cycling or walking?

I feel included....Do you have lots of friends and people you like to talk too?

I feel confident.....Do you believe in yourself?

I feel hopefulDo you look forward to the future?

I feel skillful...Do you have the skills and abilities to do the things you want to do?

Completion Questionnaire

Evaluation Form for CNC Craft Digital Training Hub

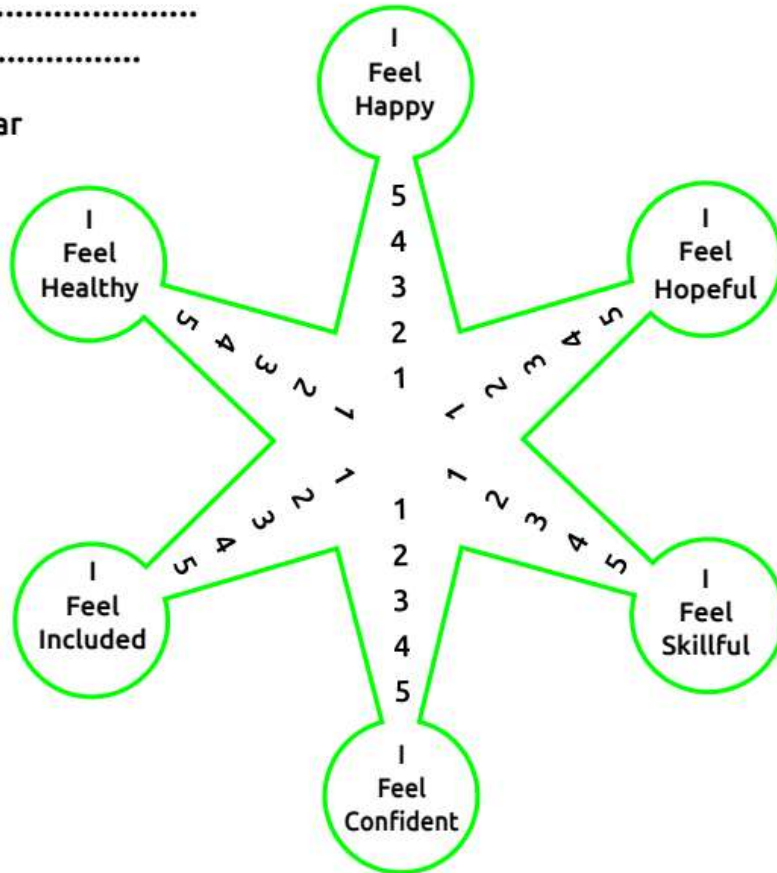
Please fill this page in after the session

Name.....

Date.....

Wellbeing Star

- ☹ = 1
- ☺ = 2
- 😊 = 3
- 😄 = 4
- 😁 = 5



How did you enjoy the training session? ☹ ☹ ☹ 😄 😄

How easy did you find learning the software ? ☹ ☹ ☹ 😄 😄

How easy did you find using the equipment ? ☹ ☹ ☹ 😄 😄

Would you want to return and make something else? Yes No

If yes, what would you like to make

Do you have any comments