

D&T Making a Difference in Black Ethnic Minority Education: the Sheffield LEA ICSYS Partnership

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Abstract

An innovative interpretation of the Inequality Challenge for South Yorkshire Schools (ICSYS) project by Sheffield LEA has resulted in a partnership between the LEA, local schools and Sheffield Hallam University (SHU). The aim of the project is to provide black ethnic minority (BEM) pupils with a high quality Design and Technology (D&T) experience, which promotes career opportunities in the field of contemporary manufacturing and engineering. To achieve this aim computer aided design and manufacturing (CAD/CAM), acknowledged as a highly motivating aspect of the modern D&T curriculum, has been selected as the vehicle for the teaching and learning experiences that the pupils will be exposed to. The project is funded by Objective 1 European Social Funding via the Learning and Skills Council.

To achieve the aim the project incorporated the following elements:

- DATA accredited CAD/CAM INSET in Speedstep and Artcam for teachers in participating schools.
- A programme of pupil visits to manufacturing industry where the focus was on applications of CAD/CAM processes in 'high tech' industry.
- CAD/CAM workshops for pupils in the university where they participated in small group activities led by D&T initial teacher education (ITE) students.
- The development of innovative CAD/CAM projects with the aim of encouraging BEM pupils to consider careers in 'high tech' manufacturing.
- Opportunities for BEM pupils to gain experience of 'university life'.
- Follow up CAD/CAM teaching in schools by university staff.
- Opportunities for pupils to develop their presentation skills.

Initial research drawn from industrial sources highlighted the need for increasing the supply of engineers, particularly in South Yorkshire, and called for further educational initiatives. Research of national data confirmed the LEA's view that engineering and manufacturing were not strong career aspirations for BEM pupils. Further research with BEM pupils confirmed this. During the ICSYS experience pupils' views of manufacturing, particularly the 'high tech.' aspect represented by CAD/CAM were monitored by questionnaires. Triangulation of the research was by

an independent evaluation using semi-structured interview techniques. The paper concludes with details of the extent to which pupils attitudes can be changed by this type of positive intervention. Additionally, it details those areas of the project which have been particularly successful so providing helpful information to both present and future D&T teachers whose groups include BEM pupils.

Key words: Black ethnic minority, BEM, CAD/CAM, ICSYS, D&T, Design & Technology, inclusion, positive intervention, manufacturing.

The ICSYS project in context

The Inequality Challenge for South Yorkshire Schools involves Barnsley, Doncaster, Rotherham and Sheffield Local Education Authorities (LEAs) in a project to promote greater understanding of the engineering and manufacturing industry. A report carried out by the Engineering Employers Federation, Sheffield Association for Yorkshire Forward (2003:1) focuses on growth in manufacturing in South Yorkshire to the year 2007. They are clear about both the numbers and the educational requirements of employees for this projected growth.

'The employment demand to support this economic growth requires recruitment, induction and training into around a further 12,000 jobs, with about half of this number met by the recruitment or progression of employees to qualifications at a higher education standard and programmes to develop their experience to professional levels.'

The Sheffield Engineering Employers Federation (EEF) continues this theme by stating:

'The workforce of tomorrow and the day after, is at school today. But surely it must not be left to chance, and the lottery of the educational system to decide the quality of recruits that engineering and manufacturing companies such as yours will be taking on in five, ten even fifteen years time. We must attract more motivated and talented young people to the engineering industry locally; do what we can NOW to raise and maintain the calibre of school leavers and graduates coming into engineering.'

The main purpose of the ICSYS project is to educate pupils about the 'high tech' nature of modern industry and thus encourage them to consider careers in this



sector. The project targets those groups within the school population that research has shown are currently not well represented in the manufacturing sector. The Sheffield ICSYS project focuses on black ethnic minority (BEM) groups. This paper is concerned with designing, developing, implementing and evaluating this intervention. It recognises that at this stage it is possible to report on the short term outcomes with the longer term outcomes being the subject of further research.

In recent years LEAs, including Sheffield, have developed considerable expertise in intervention techniques following the implementation of the Ethnic Minority Achievement Grants (EMAG). The Ethnic Minority Achievement Grant: Analysis of LEA Action Plans concludes that:

‘...the most successful authorities gave greater priority in their use of resources central to providing:

- an advisory service for schools on the use of EMAG
- professional development opportunities for mainstream and specialist staff
- management and co-ordination functions relating to the use of EMAG
- the dissemination of good practice.’

(2002: 17)

Sheffield LEA had these points of good practice in place putting them in a good position to develop further interventions. ICSYS is one such intervention.

Sheffield has an industrial legacy of heavy engineering, which tends to foster an ‘oily rag’ image of the manufacturing industry, an impression that still appears to pervade pupils understanding of current employment opportunities in the field. This is supported by a study carried out by the Manufacturing Foundation into ‘children’s attitudes to manufacturing industry’ (2003) in the industrial West Midlands which reported that:

‘Focus groups and surveys revealed that children view manufacturing as hard work, sometimes dirty, dangerous and typically boring.’ (2003:2)

There is evidence to suggest that pupils begin to make judgements about career intentions early in their secondary education and, significantly, the influence of people traditionally providing guidance is declining.

‘Our research shows that there is a very marked decline in the level of parent’s influence between Year 7 and Year 9/10, from 87% to 53%. There is also a significant decline in the level of influence from teachers from 45% to 23%. Year 9/10 pupils rank careers adviser (44%) just behind parents...’ (2003:2)

Among the actions recommended by the report is the need to:

- demonstrate to children that manufacturing is not ‘hard work’ ‘dirty’ or ‘boring’.
- ‘improve business education links and join up the many excellent interventions.’ (2003:3)

The call from the Engineering Employers Federation for ‘motivated and talented young people’ indicates that industry requires its share of graduate employees. The University & Colleges Admissions Service (UCAS) statistics show that some identifiable groups within the population are under represented in acceptance statistics for engineering and manufacturing. BEM pupils (UK domiciled) as a percentage of acceptances on university courses has shown an increase of 8.8 % of the since the year 2000 whereas the growth in white acceptances is 6.1% . However, there is evidence that BEM applicants favour professions such as law with 22% of all acceptances, medicine and dentistry at 32% with engineering trailing behind at 18.9%. (UCAS data 2002). The reasons for BEM pupils choosing these employment routes is not part of this research.

BEM representation in the 11 to 16 age phase in Sheffield schools is significant at an average of 14.1% of the total population (Sheffield LEA Data 2003). This led the LEA to pursue the development of a strategy to promote engineering and manufacturing as an attractive career option for BEM pupils. Funding for the project was provided by the South Yorkshire Learning and Skills Council as it falls firmly within their remit of ‘bringing together for the first time education and skills training into a single planning and funding system - recognising the importance of linking learning with employment’ (Blunkett, 2001)

The Sheffield ICSYS is a significant co-ordinated intervention with a planned target of 500 pupil beneficiaries over two years. In the short term, the Sheffield ICSYS sought to monitor and analyse pupil’s attitudes during the intervention with a longer term objective of tracking 100 pupils through their education to assess overall successes of the venture. This paper reports on the research strategy adopted with an analysis of the short term results.

Developing the intervention

The SHU/Sheffield LEA team designed the intervention with the following five objectives:

- to provide BEM pupils with a hands on ‘high tech manufacturing experience which included computer aided design and manufacture (CAD/CAM) resulting in the production of an artefact;
- to organise industrial visits that would provide pupils with first hand experience of modern



- manufacturing processes;
- to allow pupils to experience university life as a 'student';
- to develop the CAD/CAM expertise of pupils in their own schools with support from their teachers and university staff;
- to provide opportunities for pupils to present their work to a wider audience of peers drawn from Sheffield LEA schools.

As the planning evolved the team decided to engage design and technology (D&T) initial teacher education (ITE) students in the delivery using the principle of small pupil groups being 'buddied' with a student 'mentor'. Six schools in the authority with a high proportion of BEM pupils agreed to participate in the project. Selection of the pupils was by school co-ordinators the only requirement being that pupils were on the LEA BEM register and in Years 8, 9 or 10. To facilitate CAD/CAM work in the schools, one or two D&T teachers from each school attended DATA accredited CAD/CAM INSET in Speedstep and Artcam software.

A key element of the organisation was the appointment of a project co-ordinator based in the university with a remit to work with schools, ITE students and industry. The co-ordinator also provided a programme of follow up work in schools, assisting teachers and pupils with their CAD/CAM project work.

The intervention for each school varied but typically, it provided pupils with the opportunity to:

- participate in CAD/CAM workshops at Sheffield Hallam University with the support of ITT students. The projects were either a CNC torch (Figure 1) or a bath bomb (Figure 2).



Figure 1: CNC torches

Pupils designed their torches using CAD software, machined the components using a CNC milling machine, heat printed an interleave layer and assembled their torch



Figure 2: Bath bombs

Pupils designed their 'bomb', manufactured a pattern using a CNC milling machine, vacuum formed a mould, cast their 'bomb' in soap, designed and printed fabric for the presentation bag.

- Gain industrial experience through day long industrial visits to company such as Coca Cola where the focus was on the use of engineering in the manufacture both product and packaging.
- Engage in a CAD/CAM project at school to develop their expertise. This was supported by university staff with further visits to the university to use equipment.
- Prepare a PowerPoint presentation for a showcase event. The aim was for pupils engaged in ICSYS to demonstrate their work to peers from other schools.
- participate in further 'high tech' activities such as robotics or laser cutting at the showcase event.

Designing the research tools

Research tools selected for the short term analysis of the intervention included the use of a pupil questionnaire to establish a base-line assessment of pupil's attitudes to aspects of their education relevant to engineering and manufacturing. As the planned intervention included information and communication technology (ICT) the first five questions focused on both computer use at home, schools and particularly within D&T. The following three questions sort information about aspects of D&T, with a final three questions about career intentions. The base-line questionnaire was given to the ethnic minority ICSYS pupils to establish their attitudes with the intention of establishing if a change in attitude could be established. Some of these questions are part of the longer term tracking study which are not reported in this paper.

Following the CAD/CAM/ university experience days and industrial visits a further questionnaire was used to:

- assess the effectiveness of the CAD/CAM experience.
- Establish if positive attitudes towards 'high tech' manufacturing had been achieved.
- Assess if pupils would consider working in a job which involves CAD/CAM.
- Confirm pupils' intentions for post 16 education and a university education.

While not a research tool an important supporting element of the project involved the ICSYS co-ordinator attending several parents evenings in the participating schools to promote post 16 pathways into engineering and manufacturing. This involved talking to both parents and pupils.

Additionally, a parallel, independent qualitative study to assess the effectiveness of the intervention was carried out using face-to face semi-structured interviews. This study provided a triangulation element to the research. Participants were the project co-ordinator, teachers in participating schools and groups of pupils. Written reports from SHU based co-ordinator provided further data. Interviews with teachers focused on management and co-ordination of the project, management and organisation arrangements in schools, identification of pupils, software training and industrial visits. Pupil group interviews were designed to elicit their experiences in key areas of the visits to Sheffield Hallam University, the industrial visits and the impact on pupil's perceptions of engineering and manufacturing. This paper uses data collected from these sources and that reported in the Sheffield ICSYS Project 1st Evaluation report, March 2004.

Results

Inset for teachers

The organisation of the CAD/CAM courses for teachers proved to be more difficult to organise than anticipated. Burgoyne (2004: 8) records that:

'The lack of funding for cover necessitated the software training to be offered as twilight sessions. In some schools this was rejected by staff due to logistical implications, or work life balance issues. In some cases the sessions clashed with school activities'.

However, teachers who made the commitment and accessed the training appreciated the opportunity. One school had five staff participating in the software training, which has resulted in a significant impact on the department.

Preparations

To ensure consistency in the delivery of the intervention D&T ITE students were prepared and briefed through teaching sessions, which dealt with both subject enhancement and delivery methods to be used during the pupils' university experience days. This included the preparation of structured teaching inputs, organisation of group work and an introduction to behaviour management strategies. A pilot in which two schools participated resulted in changes to the delivery method based on student evaluations of their performance.

Additionally, the co-ordination of the school visits to industry and the university proved to be a more demanding task than anticipated. Integrating all aspects of the project within the constraints imposed by school timetables, work experience programmes and religious festivals was frequently problematic.

Burgoyne (2004: 7), the independent evaluator of the project, recorded that the identification of pupils had not been easy. In schools with a low BEM population 'the logistics of engaging the pupils in the different elements of the project proved difficult as pupils were drawn from a wide range of classes.' Whereas in schools with a higher ethnic population pupils could be drawn from one class. He also made the following comment about difficulties experienced in selecting pupils:

'The process of identifying pupils led to a range of mixed feelings in schools. In some schools the positive discrimination of identifying a BEM cohort generated some jealousy and conflict from both white and BEM pupils. In one school some enterprising pupils overcame this by photocopying the parental consent forms so they could also be involved!' (2004: 7)

Base-line questionnaire

Regardless of these difficulties groups were identified, the overall make-up being 59% girls and 41% boys (n=105). The majority (88%) had computers at home and used them for homework with internet searches being cited as the most popular activity. In school pupils reported that the most extensively used software was Word with Corel Draw, and Techsoft Design Tools being well used. 95% of pupils recorded that they liked using computers and 92% said they enjoyed D&T lessons. Within D&T the most popular aspect of the subject was CAD work (48%) with making using tools and drawing/design work being equally popular with 39% of pupils. Before the intervention only a small number of pupils had experienced computer aided manufacturing processes. This is confirmed by Burgoyne (2004:12) who identified that 'limited ICT and CAD/CAM



equipment made follow up work difficult.’ This shortage of equipment remains a limiting factor as the funding for this element of the project did not include supply of equipment for schools. Questions about pupils post 16 educational aspirations revealed some confusion in pupils minds, particularly about routes into further and higher education. 18% recorded that they did not intend to stay on at school after doing GCSE examinations yet 92% recorded they intended going into higher education (HE) or further education (FE). It seems that there may be misunderstanding about career routes which could be a result of four of the participating

schools being 11 to 16 the other two being 11 to 18. An alternative hypothesis is that pupils may have worked out their post 16 education to be via FE and from there into HE. The results of the final question about intended careers are shown in Figure 3. The data has been collated into similar categories used by UCAS. The most popular career option seems to be law with medicine and professions allied to medicine second and third. Only two pupils recorded an interest in engineering and jobs in manufacturing did not feature in the results. Most of these careers are in the professions, however trade jobs such as electrician and plumber are recorded under construction.

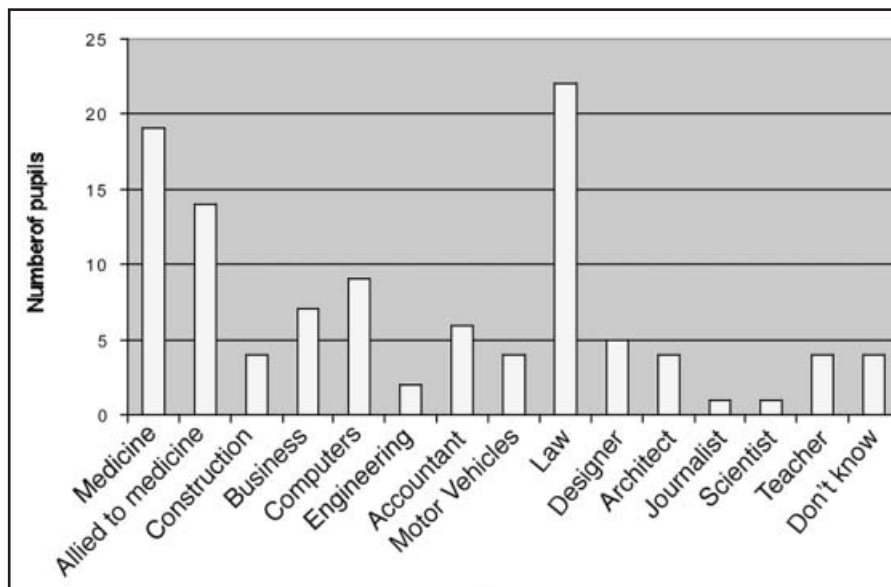


Figure 3: Intended careers of pupils (n=105)

Assessment of the post-university ICSYS experience

The post-experience questionnaire.

To ensure that the university experience days for pupils were productive the D&T ITE students organised and delivered both full group teaching inputs and small group CAD/CAM activities. Within the wider aims of the project, the opportunity for participating pupils to get a feeling for university life was seen as a very useful additional benefit. To facilitate this, a decision was made to allow the pupils as much freedom as possible, within the obvious constraints imposed by health and safety regulations and the need to complete the planned activities within the available time. This proved to a successful tactic as recorded by Burgoyne in his statement about the success of the visits:

‘It (the visit) had motivated pupils, broadened their horizons, and raised their expectations and self esteem. Pupils had experienced a different and trusting environment, and had really gained from the interaction with SHU students.’ (2004: 8)

This is confirmed by pupils recording positive comments on the post university experience questionnaire. When asked ‘we would like to you to think about the visit. If you were to come on a visit again...what would you like changed?’

- “Nothing “(thirty three responses)
- “Liked everything” (two responses)
- “It was really great” (two responses)
- “When can we come back?” (four responses)
- “I would like to try other interesting machines in the university” (three responses)
- “Everything was perfect” (two responses)
- “it was really great” (two responses)

When asked for changes the suggestions mainly concerned asking for “more time” and opportunity “to do electronics”. A small number of pupils made comments such as “ a television to watch while having lunch” and “do more things on computers”.

The questionnaire had several questions designed to assess the effectiveness of specific aspects of the

university experience. It used statements such as:

'It is very hard to learn how to use TechSoft 2D Design & SpeedStep and ProPainter at first.'

Pupils were invited to respond using a five point scale starting with 'strongly agree' to 'strongly disagree' together with a final option of 'can't choose' for those pupils uncertain about levels of agreement. Pupils were asked to complete their questionnaires on return to school which resulted in a return of marginally over 60%.

The majority had little difficulty using computers (86%) however, some 55% needed help with the CAD software, but the majority (50%) thought that it was easy to learn once they had been provided with appropriate guidance. 52% thought that using the CAD software was easier than using traditional pencil and paper methods when designing. However significantly, 81% considered that there was a fun element to using the software. Three final questions provided pupils with the opportunity to think about their future. There is evidence that D&T is regarded as an important by the BEM pupils engaged in the project with over 60% 'agreeing' or 'strongly agreeing' that it was important to get a D&T qualification.

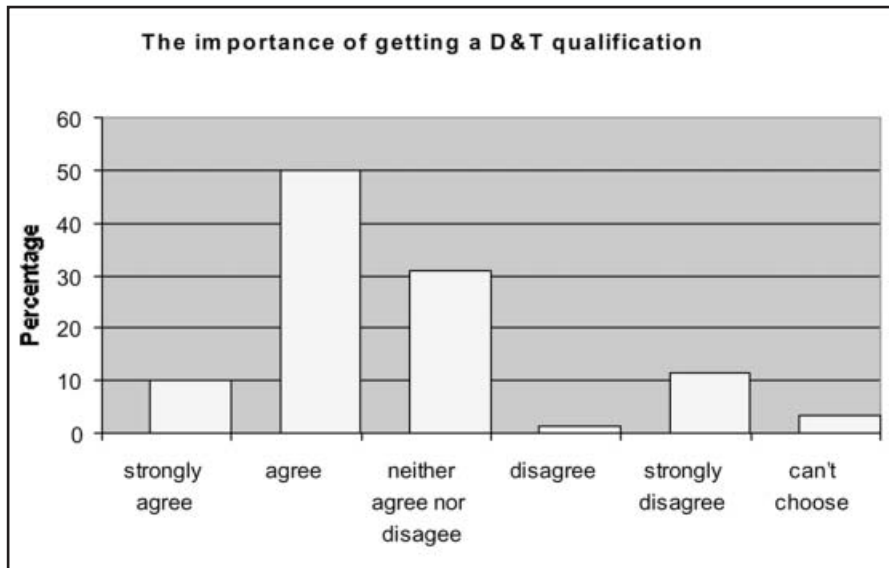


Figure 4: The importance of getting a D&T qualification (n=58)

Similarly, the evidence from this research shows that going on to a university career is important to BEM pupils however, it must be kept in mind that the base-line questionnaire revealed some confusion about pathways into higher education.

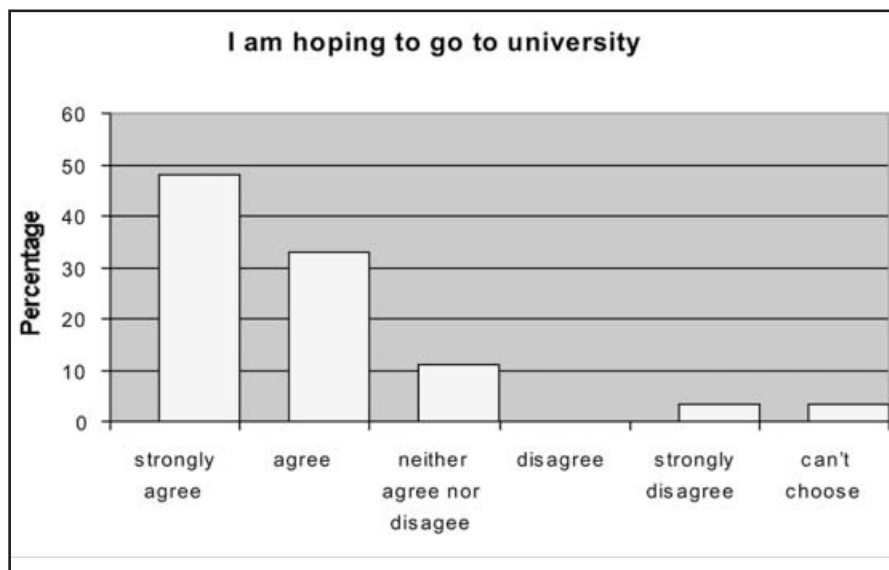


Figure 5: I am hoping to go on to study at university after I leave school (n=58)

The final question (Figure 6) about working in CAD/CAM was less conclusive with the 35% opting for 'neither agree nor disagree'. However, it is significant that 33% selected 'agree'. On the basis of these results it seems that the intervention had prompted pupils to think about careers in 'high tech' manufacturing whereas previously this had not featured strongly in their career aspirations (Figure 3). Burgoyne reports that school coordinators 'felt

that the project had little impact on the career aspirations of the pupils involved, and in general it was too early to tell.' (2004: 11) He also records that the 'high tech' CAD aspects had interested some pupils in the possibility of Computer Engineering rather than manufacturing. As stated previously the design of the intervention allowed for this with the long term tracking of 100 pupils as they move through the education system.

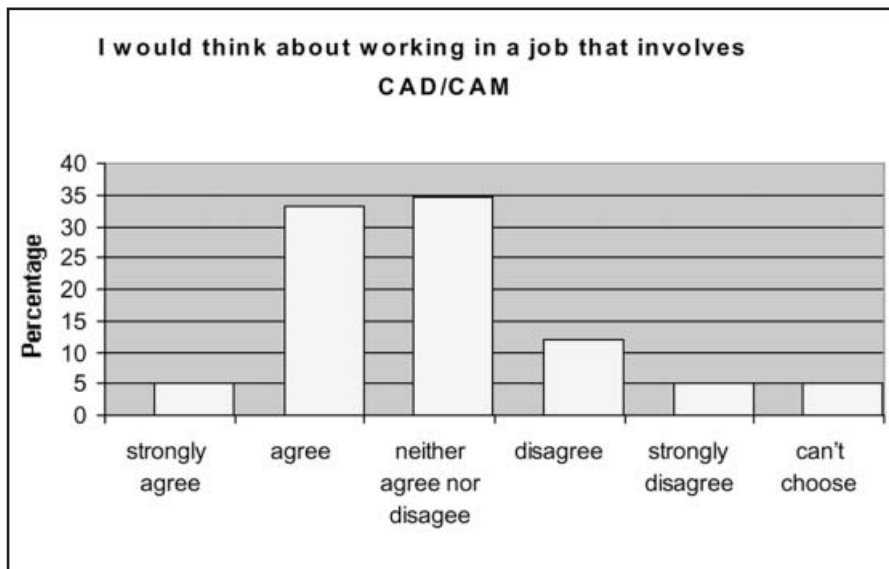


Figure 6: In the future, I would think about working in job that involves Computer Aided Design and Manufacture (n=58)

The industrial visits and follow up work in schools

The success of these was variable. The logistics of arranging visits had been problematical for schools and, in some cases the visits did not meet expectations. However, Burgoyne's assessment was:

'....all schools commented on the on the value of the industrial visits, even where the CAD/CAM and relevance to the project was limited. They had 'opened' pupils' eyes to the world of manufacturing and the range of possible job opportunities. For some pupils it had been their first experience of the world of work'.

The follow-up CAD/CAM work in schools met, in some cases, with similar logistical difficulties. More fundamental was the lack of CAM machines in the participating schools. There is considerable enthusiasm for the Show Case event which will provide participating pupils to demonstrate their achievements to pupils from other schools.

Discussion

It is anticipated that the longer term benefits of this intervention will be revealed in the future, with plans in place to track a sample of the participating pupils through into Higher Education. However, it is realistic to conclude that there have been changes in pupils' attitudes to potential careers in manufacturing, as a result of their participation in the project. Certainly, the intervention has introduced pupils to wider aspects of careers in manufacturing that may yet inform their career choices and challenge the pre-conceptions recorded in Figure 3.

There is no doubt that the university experience days were successful in introducing pupils to life in higher education. Figure 4 indicates that 81% of these pupils are likely to apply for university courses and pupils comments from the post university experience questionnaire confirm that the visits to the university resulted in positive attitudes to university life (page 9).

The evidence from the Manufacturing Foundation research 'children's attitudes to manufacturing

industry' (2003) (reported on page 2) indicates that the influence of traditional careers guidance is declining therefore interventions such ICSYS are one way of providing information about career opportunities. This is confirmed by the ICSYS co-ordinator who found that many parents were confused about pathways through education into engineering careers. One of these confusions concerns routes through further or higher education. It seems that this confusion applies to many parents and not just ethnic minorities.

Burgoyne's study shows that the project has had a beneficial effect on the D&T departments involved. The intervention had 'exposed staff to new ideas and technologies' (2004: 10). Changes were also reported in pupil aspirations as a direct result of their participation in the project:

'School coordinators felt that the project had increased pupils' expectations and self-esteem. Most commented that the project had increased pupils' desire to produce quality products for GCSE now they were aware of the possibilities following their visits to Sheffield Hallam University. Pupils were more motivated, and their skills, knowledge and interest had increased. Some school coordinators were expecting to see an increase in attainment at GCSE as a result.' (2004: 11)

While these outcomes are not exactly aligned with the intervention's aims they are worthwhile..

Conclusion

The short term results of the ICSYS intervention indicate that it has provided pupils with a positive experience of engineering and manufacturing using CAD/CAM within D&T as a vehicle for promotion. Pupils did find their attendance at university a positive experience and there is evidence that D&T in participating schools has benefited. The project continues with a 'showcase event' for pupils from none participant schools. At this ICSYS pupils will present their work along side a range of activities to further promote careers in engineering. The intervention's aim of promoting engineering and manufacturing as a good career option can only be assessed in the longer term.

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