

## A NEW CURRICULUM MODEL FOR WIDENING ACCESS TO ENGINEERING

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**Abstract:** Widening participation and increasing diversity in engineering disciplines is a key aim of the University of Strathclyde's Engineering Academy. We have a strong track record of working in partnership with the Scottish Wider Access Programme team and our partner further education colleges to provide alternative routes in to University. In this paper, we describe a new two-year pathway for school pupils in S5 and S6. The pathway was established for pupils from widening access backgrounds (SIMD 0-20, care-experienced or genuinely vulnerable), whose potential in mathematics and physics at SQA National 5 level is identified by teachers, but they may be unlikely to take 4 or 5 SQA Higher qualifications for direct entry to university. Working in close partnership with South Lanarkshire Council and New College Lanarkshire, school pupils undertake jointly delivered access programme in S5 and S6 equivalent to 4 Highers. The programme has a focus on developing engineering skills at SCQF level 6 as well as covering the syllabus of Higher Mathematics and Physics. Successful completion of the programme is accepted for direct entry to Strathclyde's Engineering Academy programme. Key aspects of the programme are students are stimulated by a new learning environment at college, develop learner confidence and independence with the partner college and prepare for university study. In the Engineering Academy, students undertake an enhanced HNC qualification and also attend the University of Strathclyde to undertake academic and practical engineering skills activities. Thus, an integrated transition pathway between school, college and university is established.

*Keywords; Access, Transition, Senior Phase Education, Further Education, Higher Education.*

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### 1 INTRODUCTION

In 2014, Nicola Sturgeon, First Minister of Scotland, challenged the nation “to determine now that a child born today in one of our most deprived communities will, by the time they leave school, have the same chance of going to university as a child born in one of our least deprived communities (CoWA, 2016).” Universities in Scotland are working towards this aim with a target of 20% of university entrants in academic year 2030 are from the lowest quintile of the Scottish Index of Multiple Deprivation (SIMD), often referred to as SIMD20. It is recognised that children

can be disadvantaged due to their socioeconomic situation before they enter school and this can be compounded by other disadvantages such that by age 14 they have lower attainment (CoWA, 2016). Closing the attainment gap in the education system is key focus and universities have also revised their admissions processes to recognise the lower attainment (US, 2017). Across Scotland, universities use contextual data about the socio-economic background of applicants to make offers for places based on reduced entry requirements compared to standard entry requirements. Universities are challenged to ambitiously use contextual offers to achieve recruitment targets; however, it is very difficult to determine from lower attainment what contribution is due to lifetime disadvantage or academic ability and what is the minimum entry requirement in order to succeed at degree level. There are a number of learners from SIMD20 areas who defy the odds and outperform their peers from less deprived areas. However, there are also many students who demonstrate potential but lose momentum through the teenage years of their school career. Universities, colleges and schools can play a pivotal role to better prepare young people to enter university and post-16 education is an important aspect of this.

In this paper, we present a new model for widening access to university education through a collaborative partnership between South Lanarkshire Council - Education Resources (SLC-ER), New College Lanarkshire (NCL) – Motherwell Campus and the University of Strathclyde's Engineering Academy (EA) programme. This model addresses a number of the 34 recommendations made in the Final Report of the Commission on Widening Access, including recommendations 4, 16 & 18 (CoWA, 2016). We will briefly introduce the Engineering Academy model and the development of successful access pathways in partnership with Scottish Wider Access Programme (SWAP West). Building on these successes we will introduce and discuss in detail the new collaborative access pathway developed for secondary school pupils in year 5 (S5) & 6 (S6). We will discuss the motivation, design process, challenges and outcomes of the new model.

## 2 ENGINEERING ACADEMY

The University of Strathclyde's Engineering Academy programme was established in 2013, as a result of a curriculum mapping exercise in 2011 to investigate the barriers to learner progression from college to university. The University of Strathclyde was awarded funding from the Scottish Funding Council in 2013-2016 to provide 80\* additional places per annum (\* increased to 100 places in 2014). The programme is a significant collaboration between the University, seven partner colleges and industry based on a 1 + 3 model, see Figure 1. Year 1 of the programme consists of an enhanced HNC programme (15 SQA HN Units) delivered by one of the seven partner colleges, 80 hours of hands-on vocational engineering skills training and academic transition material delivered by the University to help prepare students for independent university study. Students are registered with the University in year 1 and upon successful completion of year 1, progress directly to year 2\* of a BEng degree within one of the seven engineering departments in the Faculty of Engineering (\* progression to year 1 for Biomedical Engineering only). In years 2 and 3, the Engineering Academy engages with industry partners to offer paid internship opportunities for Engineering Academy students to apply to and supports students develop their CVs.

To support widening access to engineering, the EA worked in partnership with SWAPWest developing an Access to Engineering 1-year full time programme, delivered by a number of the

EA college partners. This programme has been designed to be equivalent to 4 Highers at B grade pass and allow direct entry to the EA programme. The SWAP programme model has proven successful for adults with no or few qualifications being able to return to education and study successfully at degree level. (Anderson, 2007). (Interestingly the first SWAP programmes were developed at the University of Strathclyde for engineering, as a result of de-industrialisation in the 1980's). The SWAP programme model provides a supportive academic model using SQA units. Development within a college setting where students work closely with tutors reflecting on preparing for higher education and assessing their skills for progression (student profiling). (Bridges and Flinn, 2010). The challenge for the EA and SWAPWest was to see if the established SWAPWest model could be developed further to introduce engineering at an earlier stage in a learner's journey. In 2018, the EA Associate Director, Alan Roseweir proposed the pathway to Executive Director (SLC-ER), Tony McDaid and development commenced.

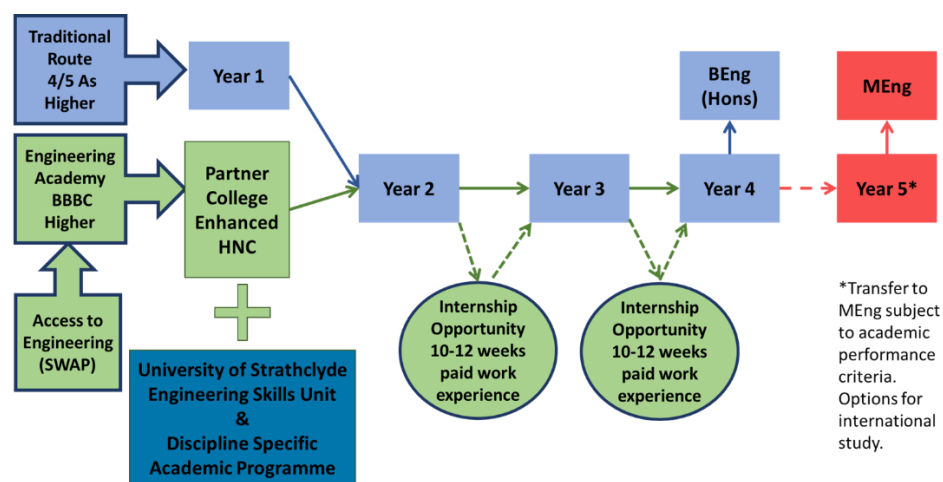


Figure 1. Engineering Academy programme pathway.

### 3 TWO-YEAR ACCESS PROGRAMME

#### 3.1 Motivation

There is a strong demand for engineers in industry and to increase the number of graduate engineers it is important to diversify students entering university (IET, 2021). The use of contextual offers for university admissions has limited scope to fully address widening access targets set by the Scottish Government and does not address closing of the attainment gap. It is also recognized that learners who performed well early in their school career can lose momentum in later years and this is exacerbated in learners from low socio-economic backgrounds (CoWA, 2016). To increase the number of applicants to university from SIMD20 communities, we propose a different approach to traditional SQA Higher qualifications and also aim to stimulate or re-engage learners and develop learner independence through changing the learning environment.

South Lanarkshire Council covers one of the largest geographical areas in close proximity to Glasgow and stretches from Rutherglen to south of Abington. There a number of SIMD20 areas within South Lanarkshire in local areas such as Rutherglen, Cambuslang, Hamilton, Larkhall and Carluke. In addition to SIMD20 criteria, the University of Strathclyde has identified 5 schools within this area that have a low-progression of school leavers going directly to university. South Lanarkshire Council's Education Resources has a large portfolio of senior phase provision in

schools and local colleges. But, a gap in this provision was identified to support learners on a pathway towards university education. Working in close partnership with South Lanarkshire Councils schools, the programme aims to identify learners with academic potential at SQA National 5 level in mathematics and physics and who meet widening access criteria but are unlikely to pursue four or five Higher qualifications for standard or contextual entry to University. The widening access criteria include SIMD20/40, entitlement to free school meals, carer role/responsibilities, care experienced or genuinely vulnerable as identified by the school. The access programme provides an alternative pathway which allows learners to develop over a two-year period and upon successful completion can enter the EA programme at the University of Strathclyde allowing them to continue to their personal and academic development with NCL undertaking an enhanced HNC award and commencing study at the University of Strathclyde. South Lanarkshire Council's secondary schools receive information about the course through the Developing the Young Workforce and the School Timetabling and Curriculum Design Depute Head Teachers' networks. This then allows schools to share the information with their learners and their families as well as other key staff in the school. Pupil Support Principal Teachers will identify those learners who may benefit from the programme and will discuss the details at Option choice and learner pathways interviews with the learner and parents/carers. In addition, in the first year a number of engagement meetings were arranged with teaching staff from participating schools along with parent/pupil evening information sessions were organised through the partnership and delivered by staff from the university.

At the development stage of the programme three working groups were established with membership from South Lanarkshire Council, (SLC), New College Lanarkshire and University of Strathclyde, (UOS). We established a Strategy group, Implementation Group and a Curriculum Group:

Strategic Group – Chaired by the Local Authority Education Directorate with representation from the UOS and NCL. The remit of this group was to agree the aims and objectives of the partnership.

Implementation Group – Chaired by UOS with representation from SLC and NCL. Purpose to develop and monitor the programme implementation plan.

Curriculum Group – Chaired by UOS with representation from SLC, appropriate teaching staff from participating schools and the curriculum leader from NCL. The remit of the group was to gain a better understanding of the curriculum content and to agree a delivery plan for the Maths and Physics element of the programme.

### 3.2 Curriculum Design

Highers are the primary qualifications evaluated for entry to Scottish universities and are at level 6 of the Scottish Credit and Qualifications Framework (SCQF); however, Highers are only 7% of all qualifications at SCQF level 6 (SCQF, 2022). The curriculum design of the access pathway is based on completion of units at Higher/SCQF level 6. The two-year access model seeks to provide underpinning knowledge in mathematics and physics and to introduce engineering specific content. A curriculum working group consisting of school teachers, college lecturers and SWAPWest was established to identify, review and select appropriate units. The final curriculum is presented in **Table 1**. SQA Unit Codes are listed in Table 1 and the learning outcomes are

specified in the unit descriptor published on the SQA website ([www.sqa.org.uk](http://www.sqa.org.uk)) and for convenience direct links are provided in the References.

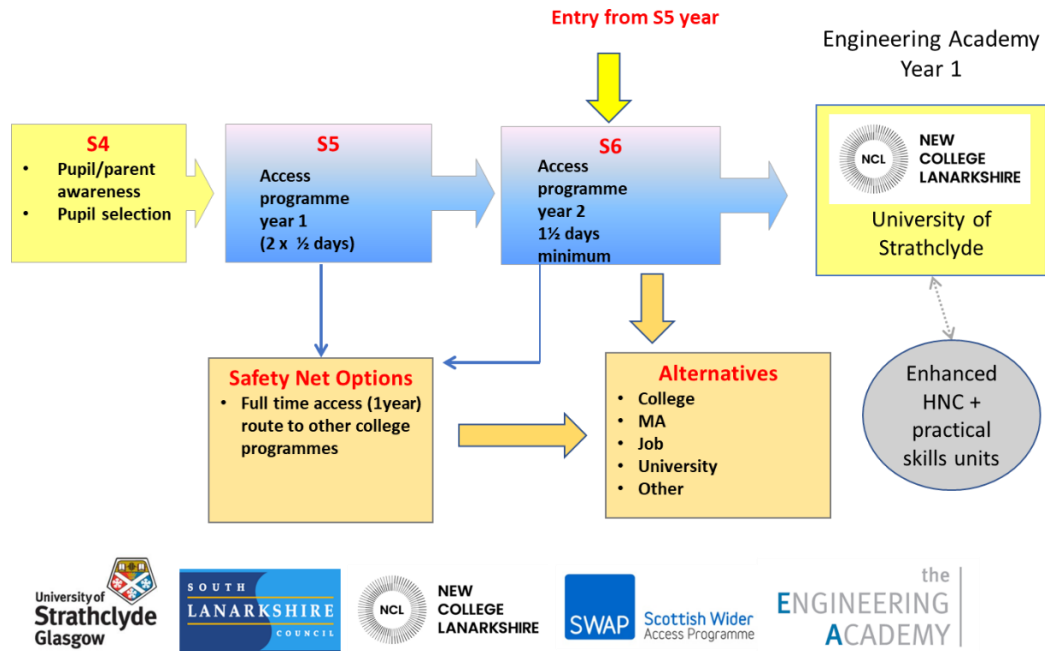
Unit Title	Unit Code	Level
<b>Mathematics</b>		
<i>Mathematics: Applications (Higher) Unit</i>	<i>H22J 76</i>	<i>Higher CFE</i>
<i>Mathematics: Relationships and Calculus (Higher) Unit</i>	<i>H4LD 76</i>	<i>Higher CFE</i>
<i>Mathematics: Expressions and Functions (Higher) Unit</i>	<i>H4LC 76</i>	<i>Higher CFE</i>
<i>Engineering Mathematics 1 (complex numbers component)</i>	<i>H7K0 33</i>	<i>SCQF level 6</i>
<b>Physics</b>		
<i>Electricity</i>	<i>H4KX 76</i>	<i>Higher CFE</i>
<i>Our Dynamic Universe</i>	<i>H4KY 76</i>	<i>Higher CFE</i>
<i>Particles and Waves</i>	<i>H4L0 76</i>	<i>Higher CFE</i>
Engineering Project	F5D5 12	SCQF level 6
<b>Core/Essential Skills</b>		
Communication	F3GB 12	SCQF level 6
Engineering: Applying Information Technology	F5D4 12	SCQF level 6
<b>Engineering</b>		
Engineering Dynamics: An Introduction	F5K6 12	SCQF level 6
Thermofluids	F5JE 12	SCQF level 6
Engineering Materials	F5KD 12	SCQF level 6
Strength of Materials	F5K9 12	SCQF level 6
Computer Aided Draughting (CAD) for Engineers	F5H5 12	SCQF level 6
Statics	F5K8 12	SCQF level 6
Engineering Workshop Skills	F5WA 11	SCQF level 5
<b>Guidance</b>		
<i>Preparation for HE</i>	<i>SWAP</i>	<i>-</i>

**Table 1. Two-Year Access Pathway Curriculum**

(delivering partner: *red [italics]* – school, *blue* – college and *black [bold, italics]* – SWAPWest)

The mathematics and physics content is aligned with the Higher curriculum. Successful completion of the access pathway is dependent on completion on the individual units through continuous assessment and is not dependent on achieving a specific grade in the Higher examination assessment. Learners are encouraged to undertake the Higher examination to gain valuable experience but the pressure of a high-stakes examination is eliminated.

The curriculum is co-delivered by the school and NCL over two years for learners in S5 and S6. The responsible partner for delivery of each unit is shown in **Table 1**. The co-delivery introduces a new learning environment and in S5 learners attend college 2 half-days per week and 1.5 days per week in S6. Introducing learners to college study brings them out of their comfort zone to challenge their learning, provides access to state-of-the-art engineering facilities and allows them to become more independent as the programme progresses. The curriculum delivery is shown in Figure 2. The primary route through the programme is shown in the top level of the schematic; however, the programme has been designed to ensure learners have alternative options if they chose to leave mid-way or decide not to progress to university study. Learners accrue SQA units which can be recognised towards further study for National Certificate courses, Modern Apprenticeships or other training routes.



**Figure 2. Two-year access to engineering pathway and programme partners.**

An important aspect of the pathway is the profiling of students as they enter, progress and leave the programme. This key aspect of SWAPWest Access Programmes (Anderson et al., 2007) was introduced to the co-delivery model to share this practice with participating schools. The student profile aims to identify learners' specific strengths and weaknesses and ensure the co-delivery team are aware of the individual learner requirements focusing on individual's development. SWAPWest worked with the curriculum working group to develop a profiling model and reporting system that could be integrated with existing IT infrastructure to facilitate compliant data sharing between co-delivery partners. The student profile enhances the academic development of a student by focusing on key skills and attributes required for succeeding at university.

### 3.3 Implementation and Challenges

The programme has been successfully implemented and in August 2022 will welcome its 4<sup>th</sup> intake of students. Key factors to the successful development of the programme include commitment at Directorship level of SLC-ER, NCL and SWAPWest. A management model was established at three levels to develop the programme: Strategy Group, Curriculum Working Group and Operational Working Group. These helped develop shared ownership across all stakeholders and commitment of resources which were key to overcoming many of the challenges. Some of the challenges faced by the partnership include school timetabling to facilitate the co-delivery of mathematics and physics content in schools but ensuring all participating schools make learners available on the same days to attend NCL. Cohort size and college timetabling was also a factor to ensure NCL could align and deliver the engineering content. Transportation costs and logistics were a primary challenge due to the large geographic area and the financial backing of SLC-ER was critical to the success of the programme. An important challenge faced by the programme was getting the buy-in of learners and their parents or guardians. A new programme has risks associated with and it was critical to ensure that the learner would not be disadvantaged in anyway and to provide reassurance of the proposed pathway and potential alternative safety net options. To



address this a series of information sessions were held for Head and Depute Head teachers and also for learners and their parents or guardians. Finally, the programme also experienced significant challenges due to the COVID-19 pandemic. The delivery mode changed to online learning and challenges of digital poverty were addressed by provision of Chromebooks and broadband dongles to ensure all learners were able to access the educational resources.

#### 4 CONCLUSIONS

The University of Strathclyde is a socially progressive, leading international technological university which aspires to increase opportunities for people from different socio-economic backgrounds. The discipline of engineering is based around problem solving and it is widely recognised that increasing diversity with engineering teams brings a wealth of different perspectives to solve the most challenging problems (RAE, 2018). However, to educate engineers for the future universities cannot work alone and close partnership working across all levels of education is important to help close the education attainment gap and provide equity of opportunity for all learners no matter if they are from the most or least deprived communities. The two-year access programme presented, provides opportunity for inquisitive, bright learners to develop their education in engineering, build confidence and learner independence in a supportive pathway through school and college. The programme aligns with the EA to help widen access to university and the transforming experience that education can provide. To date, 4 students (1 AY2020, 3 AY2021) have joined the EA programme and their academic progression will be monitored to evaluate the success of the access pathway.

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