DEGREE APPRENTICESHIPS IN ENGLAND: TRANSFORMING ENGINEERING EDUCATION

Josie Rothera*, Chris Gorse, Andrew Swan
Leeds Sustainability Institute, Leeds Beckett University, UK

Abstract: This paper will summarise some of the findings from an Engineering Doctoral project, spanning three years. The research is about degree apprenticeships in England, specifically the ones in civil engineering at Level 6. The new Apprenticeship Standards were approved in 2017, with the first wave of civil engineering Degree Apprentices emerging in 2020. The paper will seek to understand how learner approaches to the apprenticeship have changed within a year and draw out any improvements that will support new ways of working with specific reference to Covid. The research adopted an established methodology, gathering qualitative data from two questionnaires taken a year apart. Software analyses was undertaken to uncover any underlying constructs between the questionnaires. The research will lead tripartite contributors to evaluate and consider how to support apprenticeships. This research will be added to early body of works for degree apprenticeships and will present practical examples of interventions that could be used by contributors to lead to successful outcomes.

Keywords; degree apprenticeship, civil engineering, skills, LSI, improvement, education.

**Correspondence to: C.O. Josie Rothera, Leeds Sustainability Institute, Leeds Beckett University, Woodhouse Lane LS2 8AG. E-mail: josie@plprojects.co.uk*

1. INTRODUCTION

The Institute for Apprenticeships and Technical Education (IfATE) in England was established by the Enterprise Act 2016 to ensure that new standards and qualifications (for apprenticeships) would meet employer demand, sponsored by the Department for Education (DfE) (Powell, 2019). It followed calls from industry for reform to the apprenticeship system (Leitch, 2006; Richard, 2012) and in engineering and the built environment the ever present call for increased skills and workers to support the pipeline of upcoming work (Construction Industry Training Board, 2021; Construction Leadership Council, 2018; Infrastructure and Projects Authority, 2021) meant that a work based learning approach for a higher skill set was one practical solution. Apprenticeships can be categorised into higher apprenticeships (HA) and degree apprenticeships (DA). The apprenticeship is a tripartite relationship: the apprentice, the employer, and the training provider (TP). The main characteristic of DAs is that they will have an undergraduate Level 6 degree as part of the programme, most of which are currently non-integrated. This means that the undergraduate degree award remains the ownership of the Higher Education Institute (HEI), the TP, and the EPA is assessed by a separate party – the End Point Assessment Organisation (EPAO), in this case for civil engineering the Institution of Civil Engineers (ICE). The full Level 6 can be completed in 66 months (five years for degree plus six months) however some HEIs have allow

https://doi.org/10.17868/strath.00082023

apprentices to join with Recognised Prior Learning (RPL) and this duration is reduced to 30 months (two years for degree plus six months).

Degree apprenticeships fall into the category of vocational training rather than a part time degree course, incorporating not just the core learning content for the academic programme, but also the interpersonal and professional development skills and behaviours. Engineering employers will have a crucial role in skills and behaviour development and to align workplace learning with academic material to help with apprentice learning.

Whilst apprenticeships in engineering are not new ideas, bringing a higher academic level of qualification alongside the work-based learning is. Engineering education at Level 6 is being changed though apprenticeships to support specific development across a defined period and this is presenting challenges to all contributors. The research seeks to understand the apprentice learning experience of balancing academic studies with workplace responsibilities using established questionnaires. The data will then be analysed to uncover any changes and underlying constructs. The data was captured from two contact periods with apprentices: the pilot and the main study. The research will lead tripartite contributors to evaluate and consider where apprenticeships, and similar skills development frameworks can support the industry workforce.

2. LITERATURE REVIEW

2.1 Learning theories

Learning theories were developed initially from psychology and psychiatry research, considering learning from a development and age point of view. There are four main types of learning theories. Behaviourist theory seeks to use reinforcement and reward to engender and promote the desired behaviour. It dismisses the influence of mental variables, believing the learning is influenced solely by physical variables, and that responses can be determined and conditioned (Reimann, 2018). Cognitive theory is explained using the analogy of the mind as a computer: as the learner develops, so does the way they can take on the information, process that information and use that information to produce outcomes. This theory can often be referred to as cognitive constructivism, with knowing, transformation and understanding action being of paramount importance in the four stage model (Piaget, 1936). Constructivism is 'an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner' (Elliott, 2000). Constructivism is described in three categories: cognitive (discussed previously), social constructivism and radical constructivism. Social constructivism posits that individuals are active participants in the creation of their own knowledge (Schreiber, 2013) and places emphasis on facilitations of interactions and discussions to maximise understanding. Radical constructivism will not apply to this research and the Humanist theory seeks to encourage the learner to take own responsibility to the learning and seek how what is relevant for them, and how they best learn this.

Another learning theory that is relevant to this research is phenomenology. Phenomenology is a concept derived from social theory by Edmund Husserl in 1906. A phenomenological approach is interested in the subjectivity of the observer, but it need not be confined to the level of the individual (Education Studies, 2021). If there is one unifying idea behind the idea of phenomenology it is an intense concern about the way the world appears to the person experiencing the world (Moran, 2000).

2.2 Learning style inventories (LSI)

Learning style is a concept derived from psychology and refers to the way individuals prefer to process new information and strategies they adopt for effective learning. In the 1970s educational researchers began to investigate how students learn from a phenomenological perspective, moving away from assumptions about personality characteristics and placing greater emphasis on choices the individual makes in selecting an approach to a learning task (Duff, 2004). A key report: *Should we be using learning styles? What research has to say to practice*, highlighted 13 major models of learning styles (from a total of 71) from 1962 to 2002 that were considered for their use, application and reliability (Coffield, 2004). The research identified personality type and preference type instruments that had been developed as early as 1962 (Myers-Brigg Type Indicator) up until around 2002 (Jackson's Learning Styles Profiler), and critically evaluated each instrument against a set of criteria. In most cases, the methodology are question sets that ask the learners to determine their preference amongst multiple choice answers. The questions are presented as situations, and generally scored on Likert scales.

Learning styles have been as grouped based on a scale from fixed learner tendencies or to abilities to adjust preferences for learning (Farid & Abbasi, 2014; Hall, 2005; Hawk & Shah, 2007). The fixed learner tendencies looks at how students learn based on theories surrounding learner's cognitive development, with the other end of the scale considering the role of the environment as to how the learner will approach the learning. The benefit of understanding how a learner approaches studying will be valuable to the apprenticeship, allowing adjustments to be made to the design of course programmes (delivery and assessments) and both for setting the learning and workplace environments. This could have a considerable motivational effect both for the apprentices, the training provider and the employer (Hall, 2005).

In *'What does it take to learn? Some implications of an alternative view of learning'* (Marto, 1976) which described deep-level and surface-level processing experiments for students in higher education to understand their approaches to learning (Richardson, 2015). Their research was based on the notion that the learner would adjust their learning style based on the subject content and the context of their environment. For a deep approach to learning, the learner looks to establish reasoning behind what is being taught to the extent that they would look to strengthen their understand by connections with other affiliated learning material within that subject. In a surface approach, the learner considers the learning material as transient knowledge that acts only to address progression to the next level and does not integrate learning any further. Ramsden (1981) identified a third approach to learning, strategic, where the learner will use the course syllabus and assessment information to make a judgement as to what knowledge and skills would be required to progress to the next level and identify the key links between topic areas.

This theme of research created a new conceptual framework known generically as "student approaches to learning" (SAL) theory (J. B. Biggs, 1993). SAL theory has become a meta-theory for conceptualising teaching and learning, which has gone in two major directions: 1. phenomenography and 2. constructivism and systems theory (J. Biggs, Kember, D., & Leung, D.

Y. , 2001). The methodology used for this research was based on Entwistle's phenomenological approach to learning.

3. METHDOLOGY

3.1 Pilot LSI

The pilot LSI was carried out using the Revised Approaches to Studying Inventory (RASI) (Entwistle and Tait, 2013) in 2020. Apprentices were asked to complete the 18-item short form, which has six items on each of three scales: Deep, Strategic and Surface. On each item, apprentices chose one of the following: 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, or 1=Strongly Disagree. Google forms was used to capture this data. The apprentices' answers were downloaded into an Excel data file and this data file was imported into the Statistical Package for the Social Sciences (SPSS) for analyses. Following the Approaches and Study Skills Inventory for Students (ASSIST) guidance, subscale scores were assigned by computing the total scores across the relevant items, and therefore these scores vary between 6 and 30. Scale scores were similarly assigned by computing the total scores across the relevant subscales (Entwistle & Tait, 2013). At the end of the questionnaire, there was an opportunity for the apprentices to include any further information about their experiences that would be used to support statistical finding.

3.2 Main LSI

The main LSI was undertaken in 2021 and followed the same methodology as previously described with six additional questions included. This was amended following a discussion with a TP where it was considered the questions were negatively presented and affect the outcome of the LSI. The six questions were chosen from the longer ASI 52-item. The 18-item instrument was therefore re-designed to a 24-item instrument, retaining the comments box at the end of the questionnaire. To allow a greater sample size to be captured from across England, the researcher enlisted the support of the ICE, employers, and TPs to call for participants to undertake the questionnaire.

4. DATA ANALYSIS AND DISCUSSION

4.1 Descriptive statistics

The 18-item instrument pilot LSI was filled in by 42 participants who were studying in West Yorkshire and the 24-item instrument main LSI by 136 participants across England. One year separated the studies. The average age for the pilot was 23.9 years old, the oldest 39 and the youngest 19 and for the main 23.2 years old, the oldest 46 and the youngest 18.

Initial checks were made to consider adequacy. A Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value is said to be satisfactory above 0.6, and better above 0.8 (Hutcheson, 1999). For the pilot LSI this KMO was 0.638 and the main was 0.715. In both studies, the Bartlett's test were statistically significant with a p-value < 0.001.

4.2 Comparison tables

To find any underlying constructs between the questions, Principal Axis Factoring (PAF) was used. This technique assumes that a casual model exists so that all the variables are linked in some way and can be used to generalise to the population sample. It follows the assumption that variance, or difference, does in fact exist and it will look for this amongst the data. The output of PAF is the correlation matrix. For any extreme cases of, or low cases of, multicollinearity (>0.8 or <0.3), these were removed. Figure 1 shows the output from the two studies, the pilot on the left and the main on the right.

		Deep			Strategic			Surface		
		Seeking meaning	Relating Ideas	Use of Evidence	Time Mgt	Achieving	Organised study	Unrelated memorising	Lack of purpose	Fear of failure
Deep	Seeking meaning	1.000								
	Relating Ideas	0.458	1.000							
	Use of Evidence	0.586	0.447	1.000						
Strategic	Time Mgt	0.523	0.466		1.000					
	Achieving	0.376	0.302		0.738	1.000				
	Organised study	0.328	0.411	0.400	0.410	0.404	1.000			
Surface	Unrelated memorising		0.426				0.300	1.000		
	Lack of purpose								1.000	
	Fear of failure							0.497	0.451	1.000

		Deep				Strategic				Surface			
		Seeking meaning	Relating ideas	Use of evidence	Interest in ideas	Time management	Achieving	Organised study	Alertness to assessment	Unrelated memorising	Lack of purpose	Fear of failure	Syllabus boundness
Deep	Seeking meaning	1.000											
	Relating ideas	0.541	1.000										
	Use of evidence	0.457	0.437	1.000									
	Interest in ideas	0.335	0.427	0.377	1.000								
Strategic	Time management					1.000							
	Achieving		0.340		0.359	0.599	1.000						
	Organised study					0.473	0.454	1.000					
	Alertness to assessment								1.000				
Surface	Unrelated memorising				-0.315					1.000			
	Lack of purpose					-0.345				0.438	1.000		
	Fear of failure						-0.359			0.507		1.000	
	Syllabus boundness												1.000

Figure 1 Pilot vs main LSI correlation matrix tables

Where there are large variances, or commonalities in the same approach this can be explained by the participants having a preference to that approach. Where there are variables crossing the approaches, these are areas for further investigation. In the pilot LSI, the participants had both deep and strategic tendencies to their studies with the highest cross approach variable of 0.523 between *time management* and *seeking meaning*. As the participants were able to manage their time more, they were able to spend that time on understanding the learning material more, using a deep approach to connect their theory to practical application.

In the main LSI, the participant approach has shifted. There is no longer a clear deep-strategic link, but instead the variables of *lack of purpose* and *fear of failure* have become negatively correlated on the deep and strategic scales. Negative correlations are characterised by the variables working oppositely to one another so that when one increases, the other will decrease. In this case, if *time management* becomes difficult, the participants will tend to feel a *lack of purpose*, and similarly when they are not *achieving* in their learning, a *fear of failure* takes over. This should make sense for any learning, however in the context of the degree apprenticeship, and in relation to how the participants answered the LSI a year previously, this is significant.

To allow the data loadings to be better understood, it is possible to calculate the loadings for each variable on each factor using rotation methods. This allows the factors found to be further distinct from one another and to reveal the variables that relate closely with that factor. An output of this rotation that will help design the focus group questions is the structure matrix. Figure 2 shows the structure matrix for the pilot LSI (left) and the main LSI (right).

	Factor		
	DEEP	STRATEGIC	SURFACE
Seeking meaning	-0.640	0.483	
Relating Ideas	-0.632	0.468	
Use of Evidence	-0.845		
Time Management	-0.433	0.985	
Achieving	-0.341	0.740	
Organised study	-0.518	0.460	
Unrelated memorising			0.704
Lack of purpose			0.437
Fear of failure			0.769

	Factor		
	DEEP	STRATEGIC	SURFACE
Seeking meaning	0.688		
Relating ideas	0.746		
Use of evidence	0.608	0.320	
Interest in ideas	0.594		-0.413
Time management	0.331	0.740	-0.333
Achieving	0.414	0.717	-0.391
Organised study		0.676	
Alertness to assessment		0.317	
Unrelated memorising			0.795
Lack of purpose	-0.316	-0.309	0.561
Fear of failure		-0.376	0.535
Syllabus boundness			

Figure 2 Pilot vs main LSI structure tables

This reinforces what was seen in the correlation matrix tables, that in 2020 the participants had clear links to a deep-strategic approach, but in 2021, the surface approach to learning was being used more. Significantly, in three variables there were loadings on every approach: *time management*, *achieving* and *lack of purpose*. The variables of *interest in ideas*, *achieving* and *fear of failure* are identified as having motivational aspects for the participant.

A Cronbach's alpha reliability test was taken on both studies. Kline (1999) states generally accepted values of >0.7 for the Cronbach's alphas, however >0.6 could be referred to as "satisfactory" and "sufficient" (Taber, 2018). In all cases except one (0.690), the scores were >0.7.

4.3 Supporting qualitative comments

Included in each LSI was a comments box that some participants choose to use. In the pilot study, nine participants gave feedback, and the majority was positive. Extracting from this pertinent information relating to Covid, in 2020 it was clear that there were some reservations about the impact of online teaching on their learning, and the national lockdowns:

"Interactive lectures that assist in the drawing designs are important, I think this may be difficult with moving forward to online learning" and *"I find it very difficult fitting in a full-time post, a family and uni work/ revision. Especially at the moment when I am working from home and home schooling 2 children. Loading up videos takes a very long time, and my connection keeps dropping and I am worried about sitting exams on my home computer / internet."*

There was a positive comment in relation to online teaching: *"Having module revision materials online lets me reword the content into an easy-to-remember format without relying on getting it all down in lectures."* In the main study, 54 participants provided comments. These were then grouped into lead contributor for the improvement or observation. 39% of the comments could be linked to the apprentices, 35% to the employer, 22% to the TP and 6% was a mix of employer and TP. This categorisation has helped with the next stage of the research not discussed in this paper.

Some qualitative comments from the main study indicated more some preference to online learning, assessment and how capturing teaching via recordings was beneficial for revision: *"I think that the online exams are a better approach to this type of apprenticeship as it better reflects real world engineering situations. This is because you have all your notes/resources available to* *me like I do when working rather than trying to remember things that would normally be to hand in a standard or example piece of work"* and *"Due to COVID, all our lectures have been recorded and are available at any time, rather than relying on the weekly contact time with our tutor. I find having lectures available to me whenever I want to revise very helpful, and I hope that this doesn't stop when the university opens up again."*

Balanced with this positive stance on online learning, there were a couple that felt online teaching and learning was not the best approach for them: *"The course is extremely challenging, especially on zoom. My biggest issue has been with lecturers and understanding their teaching methods. When there is lack of understanding, some are unable to answer or teach efficiently and I firmly believe improvement in teaching will ease the whole course."* and *"COVID made it hard to feel confident with learning. I think in person teaching will boost confidence when this is more possible."*

5. CONCLUSION

Degree apprenticeships are a new (albeit not reinvented) way to achieve professionally qualified engineers earlier in their careers which will support a growing industry pipeline of work that need supporting skills. Interventions that were captured through qualitative data include better mentor support in employer groups and improved TP and employer communication. Improvement areas that were captured include a strengthening of the understanding of the standard itself which should include clear roles and responsibilities and to create a better progression structure for apprentices. A person who has completed the degree apprenticeship will be more experienced and better equipped, both with interpersonal and technical skills, than most graduates, therefore better economic value to an organisation. This should be the business case for organisations to incorporate degree apprenticeships and therefore skill development and retention as an approach to engineering education, into their business models.

6. REFERENCES

Biggs, J., Kember, D., & Leung, D. Y. . (2001). The Revised Two Factor Study Process Questionnaire: R-SPQ-2F. *The British journal of educational psychology, 71*, 133-149.

Biggs, J. B. (1993). What do inventories of students' learning processes really measure? A theoretical review and clarification. *British Journal of Educational Psychology, 63*, 1-17.

Coffield, F., Moseley, D, Hall, E, Ecclestone, K. (2004). *Should we be using learning styles? What research has to say about practice*. Retrieved from http://hdl.voced.edu.au/10707/64981

Construction Industry Training Board. (2021). *Industry insights: labour market intellegence. UK 2019-2023*. Retrieved from https://www.citb.co.uk/media/2nfpuwdc/csn-uk-full-report-final.pdf

Construction Leadership Council. (2018). *Skills Workstream: 2018 Strategy and Action Plan*. Retrieved from http://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2018/07/Skills-2018-Strategy-Action-Plan-July-2018-v2.pdf

Duff, A. (2004). The Revised Approaches to Studying Inventory (RASI) and its Use in Management Education. *Active Learning in Higher Education, 5*, 56-72.

Education Studies. (2021). What is phenomenology? Retrieved from https://warwick.ac.uk/fac/soc/ces/research/current/socialtheory/maps/phenomenology/

Entwistle, N., & Tait, H. (2013). Approaches and Study Skills Inventory for Students (ASSIST) (incorporating the Revised Approaches to Studying Inventory - RASI).

Farid, S., & Abbasi, S.-U.-R. (2014). Learning Styles: History, Conceptualization and Continuum. *Social Sciences Review, 02*, 15-31.

Hall, E., and Moseley, D. (2005). Is there a role for learning styles in personalised education and training? *International Journal of Lifelong Education, 24*(3), 243-255. doi:10.1080/02601370500134933

Hawk, T. F., & Shah, A. J. (2007). Using Learning Style Instruments to Enhance Student Learning. *Decision Sciences Journal of Innovative Education, 5*(1), 1-19.

Hutcheson, G., Sofroniou, N. (1999). *The Multivariate Social Scientist: Introductory Statistics Using Generalized Linear Models*. Thousand Oaks, CA.: Sage Publication.

Infrastructure and Projects Authority. (2021). *Analysis of the National Infrastructure and Construction Pipeline*. Retrieved from https://www.gov.uk/government/publications/national-infrastructure-and-construction-pipeline-2021

Kline, P. (1999). *The Handbook of Psychological Testing* (2nd ed.). London: Routledge.

Leitch, S. (2006). *Prosperity for all in the global economy - world class skills*. Retrieved from https://dera.ioe.ac.uk/6322/1/leitch_finalreport051206.pdf

Marto, F. (1976). What does it take to learn? Some implications of an alternative view of learning. ln NJ Entwistle (ed.), Strategies for Research and Development in Higher Education. In: Amsterdam: Swets and Zeitlinger.

Moran, D. (2000). *Introduction to Phenomenology*. New York: Routledge.

Piaget, J. (1936). *Origins of intelligence in the child.* London: Routledge.

Powell, A. (2019). *Apprenticeships and skills policy in England*. Retrieved from https://dera.ioe.ac.uk/32868/7/SN06113%20%28Redacted%29.pdf

Ramsden, P. (1981). *A study of the relationship between student learning and its academic context.* (Ph.D.). University of Lancaster, Unpublished.

Reimann, A. (2018). Behaviorist Learning Theory. In J. I. Liontas, T. International Assocation, T., Dellicarpini, M (Ed.), *The TESOL Encyclopedia of English Language Teaching* (pp. 1-6).

Richard, D. (2012). *The Richard Review of Apprenticeships* Retrieved from https://www.gov.uk/government/publications/the-richard-review-of-apprenticeships

Richardson, J. T. (2015). Approaches to Learning or Levels of Processing: What Did Marton and Säljö (1976a) Really Say? the Legacy of the Work of the Göteborg Group in the 1970s. *Interchange: A Quarterly Review of Education, 46*, p239-269.

Schreiber, L. a. V., B.E. (2013). Social Constructivist Teaching Strategies in the Small Group Classroom. *Small Group Research, 44*(4), 395-411. Retrieved from https://journals.sagepub.com/doi/abs/10.1177/1046496413488422

Taber, K. (2018). The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education, 48*, 1-24.