Apprenticeship: Restoring Imagination and the Senses to Vocational Education

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Glossary and Abbreviations

AI	Artificial Intelligence
BFI	British Film Industry
CEDEFOP	The European Centre for the Development of Vocational Training
CPA	Certificate in Insurance Practice
EDI	Equality, Diversity and Inclusivity
ESB	Electricity Supply Board
EU	European Union
FE	Further Education
FETAC	Further Education and Training Awards Council (Ireland)
GPT	Generative Pre-trained Transformer
GTO	Group Training Organisations
IEEE	Institute of Electrical and Electronic Engineers
IFAC	International Federation of Automatic Control
INSYTE	Centre for INformation SYstems and TEchno Culture
NLM	Natural Language Model
OECD	Organisation for Economic Cooperation and Development
PBL	Problem Based Learning
PjBL	Project Based Learning
RTO	Registered Training Organisations
SETU	South East Technological University
STEM	Science, Technology, Engineering and Maths
STEAM	Science, Technology, Engineering, Arts and Maths
SDG	Sustainable Development Goal
TECIS	Technology, Culture and International Stability
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VET	Vocational Educational Training institutes

Dedication

This work is dedicated to my parents

Jim and Ellen Walsh

And to my sons

Ciaran and James

With my everlasting love

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I wish to acknowledge the vision, inspiration and support of Professor Maggie Gregson, my director of studies, with sincere gratitude and appreciation for her guidance in the preparation of this Commentary.

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To all the above my sincere gratitude.

The Pitchfork.

Of all implements, the pitchfork was the one
That came near to an imagined perfection:
When he tightened his raised hand and aimed with it,
It felt like a javelin, accurate and light.

So whether he played the warrior or the athlete
Or worked in earnest in the chaff and sweat,
He loved its grain of tapering, dark-flecked ash
Grown satiny from its own natural polish.

Riveted steel, turned timber, burnish, grain,
Smoothness, straightness, roundness, length and sheen,
Sweat-cured, sharpened, balanced, tested, fitted.
The springiness, the clip and dart of it.

And then when he thought of probes that reached the farthest,
He would see the shaft of a pitchfork sailing past
Evenly, imperturbably through space
Its prongs starlit and absolutely soundless –

But has learned at last to follow that simple lead
Past its own aim, out to another side
Where perfection – or nearness to it – is imagined
Not in the aiming but the opening hand.

by Séamus Heaney, (1999, p. 662)

Abstract

This Commentary brings together a collection of peer-reviewed research publications focused on human-centred engagement in education and in the workplace. It integrates these insights into the development of a Model for Apprenticeship and Vocational Education, addressing the central research question: How can imagination and the senses be restored to apprenticeship and vocational education?

Apprenticeship—arguably the oldest form of practical education—is presented as a treatise on the vocational education system. It explores its role within the philosophy of education by drawing on secondary research from key theorists whose work has shaped contemporary views on forms of knowledge, educational practice, curriculum design, and the role of imagination in the development of human societies worldwide.

Advancements in Artificial Intelligence, digital technologies, medicine, and science have been widely embraced, particularly as the world recovers from the global Covid pandemic. However, sustaining progress also requires ongoing human ingenuity and creativity—something that science alone cannot provide. A resilient, adaptable workforce committed to lifelong learning is essential. This begins with education, which itself must evolve, embracing new methods and ways of thinking to meet the demands of a rapidly changing world.

Fostering imagination calls for immersive and diverse educational experiences that recognize the importance of engaging all the senses—not just to learn how to *do*, but also how to *be*. Education should go beyond teaching how to earn a living; it should inspire a love of learning and support a system dedicated to the holistic development of the whole person.

The Commentary presents a philosophy that integrates sensory engagement into the development of personal and civic responsibility, suggesting that when applied through the Model for Apprenticeship and Vocational Education, it can support policies and educational programs aimed at building a sustainable future for both the planet and humanity.

Chapter 1 - Introduction

1. Purpose

The aim of this Commentary is specifically directed towards the research question of *'how to restore the senses and imagination to apprenticeship and vocational education'*. When combined with the body of publications it outlines my engagement in researching and reporting on the links between education, the world of work and society.

1.2 Rationale for the inclusion of Published Works

The selected publications from my body of work focus on human-centred learning within industry and vocational education, covering themes such as diversity and creativity in teaching, action research-led programme design, project-based and problem-based learning (PjBL and PBL), sustainability in workplace learning, and the interdisciplinary integration of science with the arts. A unifying theme across these works is the exploration of innovative, future-focused teaching methods that shape learners into independent, participatory, and socially responsible individuals who are active contributors to a sustainable future through the creative use of all human senses. The theoretical foundation for these studies is detailed in Chapter 2 (Literature Review), while the links between the publications and theorists are displayed in Chapter 3 (see Table 6).

The publications reflect a personal and professional commitment to fostering essential human skills aligned with the vision of the European Commission's *Industry 5.0* which outlines an evolution in digital transformation to integrate human creativity with emerging technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), cloud computing, robotics, big data, and blockchain (European Commission, 2025). In this context, the role of vocational education—particularly in apprenticeships—is crucial. Teaching and learning must evolve to foster key skills such as critical thinking, creativity, adaptability, communication, collaboration, and problem-solving.

My research is conducted both independently and collaboratively with colleagues from diverse disciplines (computer science, engineering, education, business, humanities) as part of the INSYTE (INformation SYstems and TEchno Culture) research team at South East Technological University (SETU), Ireland. We contribute to national and international projects and are active participants in the TECIS subgroup of the International Federation of Automatic Control (IFAC), connected to the Institute of Electrical and Electronic Engineers (IEEE). This global network

spans industries from aerospace to education, sharing a common mission: to promote sustainable, human-centred learning systems that are adaptable, inclusive, and future-ready.

This selection highlights examples of my research on human-centred learning, focusing on topics such as mentorship and interdisciplinary collaboration. The work includes suggestions and models for vocational education designed to support both learners and educators in achieving personal and economic growth (see Appendix 9 for full details of publications).

	Published Paper Title	Paper Type	Year
1	The Global Apprentice: Adaptable, Versatile and a Lifelong Learner	Book Chapter - Springer	2024
2	The Development of a Novel Educational Model to Successfully Upskill Technical Workers for Industry 5.0: Ireland a case study	Conference Paper	2022
3	Mentorship in Engineering: Women, Inclusivity and Diversity – A challenge for our times	Conference Paper	2023
4	Interdisciplinary Approaches in Engineering Education: Preparing Young Minds for Complex Challenges	Conference Paper	2024
5	Harnessing the Benefits of Micro Credentials for Industry 4.0 and 5.0: Skills Training and Lifelong Learning	Conference Paper	2022

Table 1: List of Publications, type and year of publication

- *The Global Apprentice: Adaptable, Versatile and a Lifelong Learner*

Publication 1 explores how education systems must evolve to meet global challenges such as climate change and biodiversity loss. It emphasizes the need for adaptable, lifelong learners capable of working across disciplines. The transition from Industry 4.0 (focused on digitalization) to Industry 5.0 (where human and technological skills combine) is highlighted, calling for a human-centred, flexible, and values-driven workforce.

Drawing on the European *HUMAN* and *INCLUSIVE* projects, the paper proposes a new educational framework that aligns macro- and micro-credentials. It promotes shared responsibility among learners, educators, and industry stakeholders in fostering innovation and societal progress. Practical solutions include blended learning, micro-credentials, and supportive learning environments (mentoring, financial and time supports). The paper concludes with a strong call for policy reforms and a global vision for a cooperative, inclusive, and sustainable workforce.

- *The Development of a Novel Educational Model to Upskill Technical Workers for Industry 5.0: Ireland Case Study*

Publication 2 addresses the need for upskilling technical workers who as a result of Industry 4.0 have been replaced by automated robots and data-driven processes significantly reducing human intervention or action in routine tasks. It recognises the need for workers to become learners capable of co-working with intelligent systems and engage in innovative, creative and

sustainable practices whilst acknowledging that traditional education providers are not sufficiently equipped to meet the unique and diverse learning needs of adult workers. The paper draws on the established concepts of Andragogy and Learner Centred Design theorists such as; Knowles, Biggs, Gardner, Bruner and Vygotsky in support of a new interdisciplinary and educational model. The new model is academically robust, flexible and responsive to varied learner needs and backgrounds informed by real world primary research conducted by one of the paper's authors in Irish manufacturing companies. The paper proposes the need for a review of outdated training models and proposes a novel educational model providing practical, scalable solutions for the development of a future-ready technical workforce.

- *Mentorship in Engineering: Women, Inclusivity and Diversity – A Challenge for Our Times*

Publication 3 stresses the need for STEM-driven solutions to the global threats surrounding our planet and highlights the ongoing underrepresentation of women and minorities in STEM careers despite women making up almost 50% of EU doctoral graduates (European Commission, 2021). Key issues include low entry rates, poor retention, and lack of leadership representation. The central research question explores how formal mentoring can support women and minorities in STEM through education and role models. Grounded in Vygotsky's socio-cultural theory and supported by further research mentoring is shown to improve career success, self-efficacy, and retention. The paper identifies mentorship qualities, barriers, and the role of visible role models in challenging stereotypes and presents the concept that while society needs diverse talent in STEM to solve global challenges it is not using its full quotient of human capital namely women and minorities. It concludes by calling for policy reforms aligned with UN Sustainable Development Goals to embed mentorship into systemic change for a more inclusive STEM future.

- *Interdisciplinary Approaches in Engineering Education: Preparing Young Minds for Complex Challenges*

Publication 4 continues my research into interdisciplinary education by exploring the integration of science, arts, and humanities. Co-authored with Austrian colleagues, it documents an international STEAM project where students and lecturers collaborated on creative initiatives like *Rainbow Cocoa Creations* and *EduFungi Constructs*. These projects used biomimetics and artistic inquiry to engage learners in solving complex scientific problems.

Grounded in the theories of Vygotsky, Kolb, and Bloom, the paper promotes education that transcends disciplinary boundaries. It emphasizes developing key competencies such as

empathy, creativity, collaboration, and adaptability, and calls for education that blends scientific rigor with the human insights provided by the arts and humanities.

- *Harnessing the Benefits of Micro-Credentials for Industry 4.0 and 5.0: Skills Training and Lifelong Learning*

Publication 5 addresses the increasing demand for reskilling and upskilling in response to rapidly evolving technologies. In both education and employment, learners must develop new competencies that support human-machine collaboration and personalized, human-centred solutions. The paper presents micro-credentials as a flexible, modular approach to lifelong learning, offering short, targeted learning pathways that are portable and stackable. It explores the essential role of digital accreditation, standardization, and transparency in ensuring trust, recognition, and value. The research demonstrates how educational institutions are embedding micro-credentials across disciplines, and how collaboration between stakeholders—learners, educators, and employers—is critical to ensuring quality assurance, interoperability, and industry alignment. This paper underlines the centrality of micro-credentials in building adaptable workforces and engaged adaptable students of all ages and from all parts of the globe.

The research conducted in the preparation of these papers on a range of interconnected topics has strengthened my belief in a human-centered approach to vocational education and inspired me to present a new model in this Commentary.

1.3 Rationale for the Commentary

The literature reviews, methodology and discussion in this Commentary focus on one of the oldest modes of learning, *apprenticeship*, and are presented here as a treatise for the research into the creation of a new model for vocational education. By choosing apprenticeship as a learning model focused on preparing individuals for employment the bridge between education and work can also be seen as a bridge to active participation in society. Throughout the papers supporting this Commentary, apprenticeship is used *as a key example that embodies the core principles* of Vocational Education. Billet (2016, p. 614) states, 'there is no separate and distinct process of learning that humans engage in other than that which arises through their construing from experience and constructing what they know, can do and value through and from that experience.'. This premise, together with the works of diverse theorists introduced and discussed in the Literature Review section, underpins all my published work and forms the foundation of this Commentary. The importance of lived experiences, shaped through all the senses, not only facilitates immediate learning but also contributes to ongoing new learning as

individuals grow and integrate into communities where their trade, craft or skill is valued and needed.

The Commentary explores and critically discusses the foundations of philosophical thought on our understanding of what it is to be a member of society. Discussion across the Commentary spans the work of both ancient and modern philosophers and how *the senses* played a part in the creation of educational practices; how the false division of mind and body arose; and how it is now imperative that acknowledgment of the part played by the senses and imagination is restored to educational practice. The literature discussed presents how practice pedagogies, curriculum practices and a personal epistemology have been incorporated into the new model, presented in this Commentary, as a contribution to new knowledge, which views education as a human-centred, life long journey of learning with our fellow humans. My argument is that this journey must essentially involve engagement with modern technologies but must also be mindful of creating conditions in vocational education and other educational context which nurture and protect the organic cohabitation and sustainability of the lives and resources on our planet for future generations. A guiding principle in all my work is that this can only be achieved through the innovative, imaginative creation of a society of humankind introduced to a vocational system designed to involve and embrace *all* of the human senses.

Maxine Green (2005, p.165) describes imagination as having the power to summon up 'visions of a better state of things, an illumination of the deficiencies in existing situations, a connection to the education of feeling and a part of intelligence.' Imagination is therefore not solely found in vocational education in the form of facts and figures, statistics and graphs but by the creation of critical and perceptive minds; the fostering of creativity involving the human senses; and by engaging in the communication of different perspectives to solve complex problems collaboratively and cooperatively; inventing novel concepts; sharing the belief that there is more than one way of doing things, while remaining mindful that as fallible human beings there is always the possibility that we might be wrong. While no system is perfect, every system is open to re-imagining or improving as progression and development are seldom achieved by eradicating the current version. The creation of this new model of apprenticeship and vocational education, presented in this Commentary, will almost certainly involve new learning and evoke resistance from outside and inside the existing system. However, it is my hope that, as with all models, it will in time be better than the ones that went before, involve new learning from the best and present a view of what *ought to be* done in the present and in the future.

1.4 Scope and Limitations of Model

The Model for Apprenticeship and Vocational Education (see figure 2) is presented as a foundation for developing new curricula in educational institutions and as a template for creating mentorship programs in the workplace, with the aim of promoting the apprentices' personal growth and development rather than preparing them for a specific workplace initiatives or new technologies.

A limitation of the study is that it does not serve as a direct strategy for attracting apprentices or learners to apprenticeship programs. However, it is hoped it will inspire the development of new curricula that offer a more holistic educational experience—one that engages all the human senses and, over time, appeals to a broader and more diverse group of individuals seeking skills, upskilling, or reskilling for employment and personal growth. The primary aim is to enhance existing vocational education and mentorship systems.

1.3 Crafts and Trades - Distinction

At this point it is necessary to differentiate between the trades and crafts. The crafts of sculpting, drawing, art, pottery and a myriad of other 'hand crafts' involving the use of artistic expression can now be studied not only in VETs but in universities and art and design institutions and from certificate to degree or doctoral level. When degrees are attained the students can then serve internships under professional mentorship, by one or more individuals, in workshops, studios or design centres. The word apprenticeship is now more commonly attributed to the 'trades' of plumbers, electricians, engineering technicians, information technologists and other trades which are evolving as technology requires human-centred involvement with robots and Artificial Intelligence (AI). Overall, skills and crafts and the arts are to be found in *practice*. Sennett (2009, p.10) describes craftsmanship (encompassing all forms of craftsmanship) as the, 'enduring, basic human impulse, the desire to do a job well for its own sake……craftsmanship focuses on objective standards on the thing in itself'. Sennett continues to describe the development of skills with two arguments: 'first, that all skills, even the most abstract, begin as bodily practices; second, that technical understanding develops through the powers of imagination' (ibid, p. 10).

In view of the above, it can be argued that craft, and the system in which it developed to form apprenticeship, was rooted in the demands of civilisation and the growth of a society striving to improve its progress successfully through the generations. Despite civilisations being separated by huge distances, languages and cultures, the system of learning from a more skilled expert crafts person has evolved, grown and perpetuated into modern times.

1.4 Apprenticeship in the 21st century

The etymology of the word 'Apprenticeship' is based on two concepts one of which dates to ancient times from the Latin 'appraehendere' meaning 'to lay hold of or grasp'. The second derives from Old French 'Apprentiz' meaning to 'teach or learn'. Ryan (1993) chronicles how apprenticeship can be dated to pre-Christian times, circa 628 BC, evidenced by small unbaked clay tablets outlining a contract for apprenticeship lasting two years and five months for a fee of two shekels of silver, which is legally binding on both parties and holds a penalty clause if the contract is broken. Apprenticeship in the 21st century retains some similarities and is defined as a young person (or older)' learning a trade or craft *with* another more experienced person' (Oxford English Dictionary, 2024). However, the practice of apprenticeship training differs from one country to another and in an effort to achieve a unified definition of apprenticeship The European Centre for the Development of Vocational Training (CEDEFOP, 2024) has recognised the term as being constitutive of 'workplace learning environments combined with Vocational Educational Training institutes (VETs)'.

The Council of Europe (2018) recommended criteria to help member states align economic growth with human capital and social development by ensuring quality vocational education for youth and adults through the following:

	Council of Europe (2018) Criteria for Vocational Education
1	That learning in education or training institutions is supplemented with substantial work-based learning in the workplace,
2	That the programme leads to a nationally recognised qualification
3	Are legally based on agreed terms and conditions between the apprentice, the employer and the vocational education and training institutions
4	That the apprentice is paid or compensated for the work based content of the training apprenticeship.

Table 2: Council of Europe (2018) Criteria for Vocational Education

Stating the acknowledged criteria of an apprenticeship does not account for the multitude of different and diverse connotations of how VETs, employers and apprentices embark on the apprenticeship route; progress through the different timeframes involved; have access to progression within the workplace environment or continue in further and higher education. The heterogeneity of the apprenticeship sector is a factor in its definitive description. The continuing expansion of the use of the term is further exacerbated with the inclusion of new apprenticeships as new disciplines are added to what was historically known as a 'craft' term and which is diversifying to include workers for 'green technologies' and 'robotic' and Artificial Intelligence (AI) systems as the world evolves and replaces some apprenticeship systems with others. It can be argued that this is the very reason why the system of apprenticeship has

survived millennia. It is constantly changing with the socioeconomic, environmental, educational and cultural demands of humanity and the rapid changes in technology with the introduction of AI systems. The origins of contemporary vocational systems, to include apprenticeships, are usually found in the creation of modern nation states in partnership with industry as means to overcome skills deficits, sustain occupational preparation, to serve particular purposes guided by regulated bureaucratic means, societal and cultural sentiments and institutional arrangements (Billet, 2026, pp.616-617).

1.5 Examples of Apprenticeship Systems

As discussed above, different countries have different arrangements with industry partners in formulating apprenticeship schemes. The following outlines some of the more traditional outlines of the dual system of time spent in the workplace and time spent in the educational setting.

1.5.1 Ireland

The Irish apprenticeship system is based on the dual system of time spent in the workplace and time spent in FE or VET colleges. It can also have places in Technological Universities where the attainment of a Level 6 qualification from the National Qualification Framework of Education allows candidates to progress to ordinary degree Level 7 and onwards in specific subjects (see Appendix 3). For example, the system for apprenticeship in Ireland to become a state certified carpenter or joiner is to be accepted by one of the Irish Government agency 'SOLAS' (solas is the Irish word for 'light') approved apprenticeship providers who will register the apprentice with SOLAS, who in turn will register the apprentice with a Department of Further Education institute to engage with formal class work.

The programme spans four years consisting of 7 phases with phase 4 and 6 being completed in educational facilities for periods of 10-11 weeks duration. The internationally recognised award for Craft – Carpentry and Joinery is at certification Level 6 on the National Framework for Qualifications (SOLAS, 2024). The apprenticeship pathway for electricians e.g. employed by the Electricity Supply Board (ESB) Networks is similar with network training provided in a specialised site operated privately by the ESB (see Fig. 2).

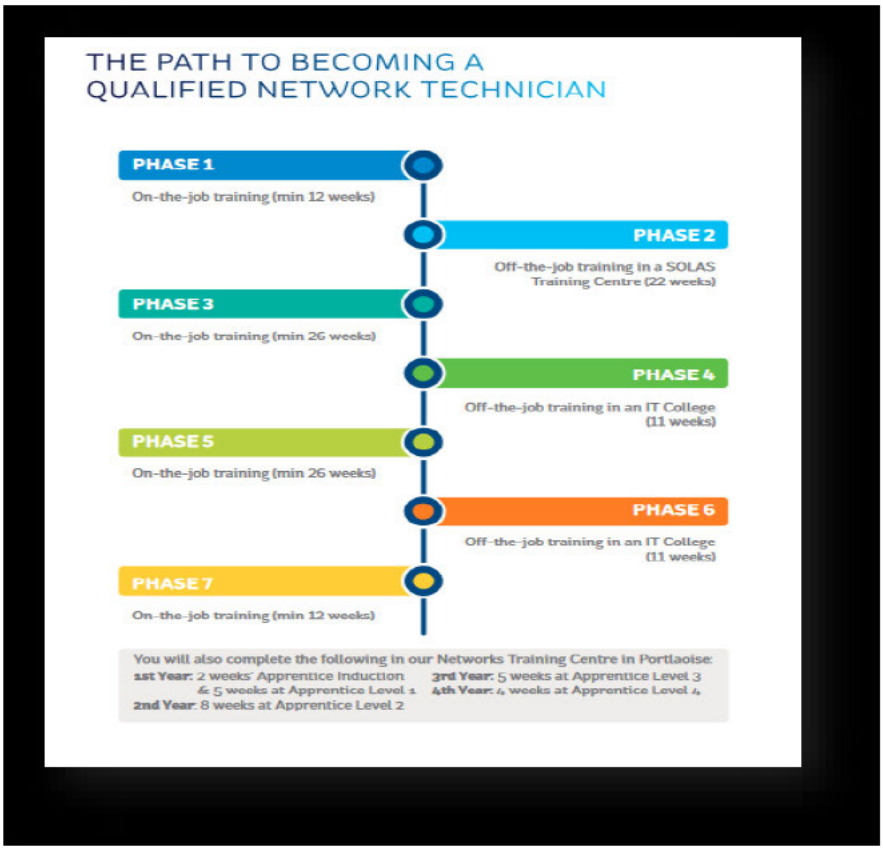

Figure 1: Irish Electricity Supply Board framework for Apprenticeship (esbnetwoks, 2024)

1.5.2 Australia

Australian apprenticeships follow a similar dual system to certification, combining workplace training with education through Registered Training Organisations (RTOs) under government oversight. Timeframes are comparable, but a key difference is the availability of government apprenticeship loans to support apprentices during the early, low-wage phase of training. These loans are repaid through the tax system once earnings reach a certain level. Group Training Organisations (GTOs) operate across all states, recruiting apprentices and placing them with suitable employers from their database (Australian Apprenticeship, 2024).

1.5.3 United Kingdom (UK)

Colleges of Further Education (FE) in the UK cater for any study after secondary level education that is not higher education. The sector consists of four countries: England, Scotland, Wales and Northern Ireland and provides a wide range of vocational, academic, technical and professional programmes. Between them they serve over 2.5 million students (James, Garner and Husband, 2023). However, they operate separately under diverse Governing Bodies and (for profit) Awarding Bodies. They colleges are linked to apprenticeship suppliers in industry and each college runs separate and diverse programmes of training and skills. The apprentice must

secure a work placement and register with an FE college for collaborative training in line with the Qualifications and Credit Framework (see Appendix 4).

1.5.4 France and Germany

In Appendix 5 the Dual Vocational system of education in Germany is outlined which bears similarities to the French model shown in Appendix 6. Both countries continue to offer subjects from the general academic curricula comprising of mathematics and literature studies to students following the vocational route and the general academic route. These are offered in *conjunction* with the specific vocational or technological subjects under study in the vocational sections possibly to a lesser degree due to time constraints but nevertheless the arts and sciences are included in both sectors of education.

1.5.5 Innovative new Apprenticeship

In recent years Sweden and Denmark have begun apprenticeships that are 'school based'. The apprentice is a student based in an educational setting and attending workplaces but fundamentally remaining a student and not an employee. In Norway an apprenticeship system now exists of a 2+2 model consisting of two years in a vocational college and two years in employment (Billet, 2016, p. 617).

1.6 The Reciprocal Link between Apprenticeship and Industry

Changing educational systems that are already in existence can be fraught with discontent and opposition as Dunne writes in '*What's the good of Education*' when reviewing the possibility of schools in Ireland defining an agenda of their own which would only in part respond to the needs of production but *not* serve them wholly. Consequently, they would face resistance as this direction would cause them to 'be casualties of the tie broken from the other direction; because of their ceasing to feed the goose there would no longer be the golden egg which feeds themselves' (Dunne, 2005, p. 149).

Apprenticeships still reflect the enduring and reciprocal link between education, production, and the economy. Improving any education system is challenging and relies on building a collaborative community with a shared sense of purpose and commitment to sustainable development. The structure of educating pupils/students/apprentices for participation in the economy workforce has been described by Joseph Dunne (2005, p.149) as the, 'interlocking of education and the economic sphere' and, 'rendering problematic the ideal of a humanistic education without utilitarian purpose'. He continues to state that the motivation to succeed in education is now dependent on the rewards or what is on offer at the *end* of the term of

education and not what is occurring *during* the journey. The 'external' rewards are higher pay, easier working conditions or a 'soft' job with benefits of health insurance, pensions and a perceived higher status in society. Dunne is cognisant of the fact that these incentives are attractive to all members of society but attainable by only a select number who want and achieve the highest grades from a system which often does not serve the '*intrinsic good* 'of education but provides it with an educational currency in a competitive market culture. By putting these factors or end rewards, as primary motivators in an educational system it, 'has in a sense gained the world, but in doing so has lost its own soul' (ibid, p. 150). What then are the 'goods' internal to any system including apprenticeship with its dual system of both employment and education? Dunne (2005, pp. 152-153) explains his interpretation of the word 'good' to be confined to the context of a 'practice' in which a person is engaged and which consists of,

> '...a coherent and invariably quite complex set of activities and tasks that has evolved cooperatively and cumulatively over time. It is alive in the community who are its insiders (i.e. its genuine practitioners), and it stays alive only so long as they sustain a commitment to creatively develop and extend it'.

Sennett (2009. P.175) refutes the concept of routine and industrial labour, as depicted by Adam Smith as mindless and that a person doing something over and over goes missing mentally, by stating that hand skills are rhythmic and can be stimulating and the emotional payoff of one's experience in doing is always constant and the skilled craftsman has extended rhythm to the hand and the eye. He quotes Emmanuel Kant (in Tallis, 2003) of casually remarking 'The hand is the window on the mind'. Dunne (2005, p. 155) observes how (young) people can be educated through the practice of woodwork, metalwork and music as engaging in the development of a practice it frees a person from 'the tyranny of the ego' as it focuses on 'goods' or practices that help people to *realise themselves in fulfilling ways*. He notes that such drives are not only rooted in the past but also present and alive in current society. They are valued and just because they are rooted in the body (incarnate) that they, as well as being forms of intelligence with the capacity to avoid, 'technocratic control and become instrumental in bringing about conditions that make our social and personal lives more just or fulfilling' (ibid, p.156). Dunne (2005, p. 145-160) refers to learners not only as, 'recipients of instruction' but also as, 'participants in conversations' and 'apprentice practitioners'. These names, as opposed to pupils/students, signify the active participation and character of their learning in practice. The attainment of the skill of understanding, questioning, making mistakes and beginning again can benefit the 'apprentice practitioners' throughout life.

Sennett (2009. p.11) in his view of practice states, 'The good craftsman, moreover, uses solutions to uncover new territory; problem solving and problem finding are intimately related in his or her mind'. He concludes by stating, 'the past life of craft and craftsmen also suggests ways of using tools, organising bodily movements, thinking about materials that remain alternative, viable proposals about how to conduct life with skill.' These are the philosophical ideations of craftsmanship from renowned philosophers but what are the real ideations and aspirations from apprentices themselves. For this view I looked at the research from Prof. Erica Smith for a comprehensive study outlined below.

1.6.1 Features of Apprenticeship Attractiveness

Smith (2023) conducted research on the topic of what constitutes attractive conditions for apprenticeships and how to increase participation in apprenticeships worldwide (see Appendix 1). Drawing on results from the findings of five major international studies (see Appendix 4), involving 47 countries worldwide, on apprenticeship conditions and requirements, the author condenses the findings into a list of inherent features and strategies for attractiveness within each report which I have summarised as follows:

The Features of Attractiveness for Apprenticeship	
1. *Likely* features of attractiveness for apprenticeships to be:	Practical hands-on experience in a workplace, demands from a workplace and workplace socialization, occupational socialization and a stipulated length of relationship with an employer.
2. *Reasonably likely* to be present in a formal apprenticeship:	Assistance in the transition from school to work, whether apprenticeships are part of secondary schooling or a school-leaving option, a pathway to post-apprenticeship work and/or education pathways, gaining of theoretical knowledge as well as practical experience, available in a reasonable range of occupations, relevant to the economy, a formal qualification or certification, some remuneration, either a salary or an allowance.
3. *Somewhat likely* to be present in a formal apprenticeship:	Extra support for disadvantaged people, offering the possibility of permanent employment, systems for monitoring the quality of work and training, involving external parties

Table 3: The Features of Attractiveness for Apprenticeship

Smith describes the desirable features of what is considered a worthwhile apprenticeship in terms of the social and personal aspirations of the apprentices involved. In the research, the

need for knowledge, practical experience, qualifications, learning whilst earning, societal integration and a pathway to further knowledge are presented as likely or reasonably likely to be a required feature of embarking on an apprenticeship. The last category of requirements seeking extra support for disadvantaged people and an external professional body to monitor training can be viewed as representing a minority of those taking part in the research. However, the fact that the case of minorities has appeared in the research is indicative of the need for these to be included in a future framework for apprenticeship training where all are represented and given equal, diverse and inclusive (EDI) opportunities to engage in educational progression and societal advancement.

In view of these research findings the question vocational educational institutions should be asking is: Can vocational education be re-imagined where apprentices are provided with the opportunity to create their own identities through exploration of new content in curricula outside their prescribed 'job related' skills? Can the Arts be introduced through subjects such as Communication Studies? Can Reflective Practices and Project Based Learning activities bring forward creativity and team building learning opportunities. I now turn to my Model for Apprenticeship/Vocational Education, which emphasizes both learning how to 'Do' (Savoir-Faire) and learning how to 'Be' (Savoir-Être). This holistic educational approach aims to develop the skills needed to become a constructive, critically thinking member of society, with abilities cultivated through engagement of all the human senses.

The Literature Review explores the foundational philosophy behind the creation of the model, drawing on the knowledge, practices, curriculum design, imagination and insights of both ancient and contemporary philosophers and educational theorists. It sets the stage for understanding how these influences shape the model's structure and purpose.

Model for Apprenticeship/Vocational Education						
Aim	To provide apprentices with the abilities to engage with the knowledge of knowing how to 'DO' and knowing how to 'BE' – to obtain skills and qualities of mind and character that will enable them to become lifelong learners and participate fully in their craft/trade/skill with care, integrity, imagination and creativity.					
Apprenticeship/Vocational Sensibility (Forms of Knowledge)						
Key Dimensions of apprenticeship, vocational Learning	Practical Reasoning/Workplace Learning Processes/Practices/Participation		Problem Finding, Problem Solving and Critique Problem and Project Based Learning and Multimodal Assessment		Qualities of Mind and Character Creative, Imaginative and Moral Practice	
Areas of Learning **Knowing how to 'DO'** **Savoir Faire**	Specificities of the practice of the craft/skill/trade Planning and preparation for practice; organisation and execution of practice; implementation of new projects, repair or renovation; equipment maintenance. Engage with the real world of work as an apprentice learner	Social personal and collaborative and cooperative practices Planning and preparation for practice; organisation and execution of practice; implementation of new projects, repair or renovation; equipment maintenance. Discover new opportunities for partnerships or collaborative work	Critical personal engagement with practice under study Planning and preparation for practice; organisation and execution of practice; implementation of new projects, repair or renovation; equipment maintenance. Engagement with the practice in all its forms.	Wider engagement with Humanities subjects (outside main subject) Engagement with the history, culture and traditions of the practice – stories and images of practice. Discover historic relationships of new and old apprenticeships or skill training – a view from the past. Using viewing and evaluating of artefacts and connoisseurship as a way into making and taking pride in a job done well. Experience the narratives and real world practical examples offered by mentors in workplace and other settings in vocational education. Discover new methods of craftsmanship from external sources. countries, cultures, disciplines	Imaginative engagement with new methods, technologies and materials. Experience of creative opportunities in the practice. Bringing new methods and technology into view critically and with imagination. Discover new technologies within and outside the specific field of study – venture outwards. Enjoy the creative skills within the craft under study	Reflective Learning Evaluate as individuals and in collaborations - identifying where improvements could be made and how. Identify, question and reflect on new ideas and values Reflect on national and world cultures and the sustainability of the earth's natural resources Engage with a lifelong learning process to advance new techniques and 'ways of doing and being'.
Qualities of Mind and Character **Knowing how to 'BE'** **Savoir Être**	Critical thinkers Confident explorers	Adventurous creators Informed Participants	Expressive communicators Effective listeners and collaborators	Sensitive contributors Enthusiastic advocates	Active collaborators Engaged Citizens	Reflective practitioners Independent and autonomous learners
Disposition for Lifelong Learning	Spirit of Enquiry	Understanding of diverse Perspectives	Hopefulness	Tolerance	Pleasure and Pride	
Connecting life and work	Responsibility for Self		Responsibility for Society		Employability	

Figure 2: The New Model for Apprenticeship/Vocational Education

Chapter 2 – Literature Review

2. Introduction

The following literature review presents the philosophies, methodologies of practice and development of curriculum design which have informed my life's work. One of my strongest beliefs is in the power of the human spirit and the use of human imagination to create; to create a better world for our children and to create a sustainability which will protect our planet's resources and beauty as it faces an existential climate change crisis. But what is knowledge and how do we attain it?

2.1 Knowledge

The processes surrounding the acquisition and attainment of different forms of knowledge have prompted centuries of theoretical discussions from ancient Greek philosophers to the present pedagogic practices of teachers, trainers and mentors across the spectrum of settings in which education is currently conducted. Competing contributions from the philosophy of education represent attempts to explain the origins of educational theory and the relationship to practice including how and why educational theory is developed and by whom. These issues continue to frame the parameters of educational discourses in the humanities, arts, sciences as well as across the field of vocational education. It is generally accepted that education will begin and end a process of attaining different forms of knowledge and develop aspects of a person's character to include virtues and values. However, this raises a number of questions including the nature and different forms of knowledge and what it means to say that someone knows or does not know something and in what way? What is the reach of knowledge, how much can be known based on reason, imagination, the senses and the words and works of others.

2.1.2 The Ancient Philosophers

In the Western philosophical tradition, the most influential account of knowledge derives from the classical Greek scholars, Socrates, Plato and Aristotle. According to Winch and Gingell (1999, p.125) the ancient philosophers decreed that for something to be 'an item of knowledge it must satisfy three conditions. Firstly, it must be believed. Second, there must be a good reason for the belief – to distinguish a real knowledge claim from a mere lucky guess. Third, whatever is claimed as knowledge must in fact, be true.' This concept of knowledge is generally accepted as the basis of continuing debate amongst philosophers and according to the above authors the consensus is to, 'somehow rescue the account rather than repudiate it.' and 'Coming to have knowledge, on this account, is a process of acquiring rationally justified true beliefs' (ibid p.

126). This traditional model has come to form the bedrock of educational policies and practice. However, this model has been contested, expanded and developed in philosophical circles from the beginning of the 20th century until the present. The study of knowledge in philosophy is known as 'epistemology' coming from the Greek word 'episteme' (knowledge, understanding or acquaintance) and 'logos' (account, argument or reason), (Stanford Encyclopaedia of Philosophy, 2024). Epistemologists are concerned, for the greater part with propositional knowledge – as opposed to procedural and acquaintance knowledge. According to Hogan (1995) the *writings* of Plato and Aristotle have led the field in the provision of educational aims and provisions but it was the *actions* of Socrates (found in Plato's writing as Socrates refrained from writing his own words) which form the essence of philosophy's teachings to be about, 'wisdom and truth and the greatest improvement of the soul' (*Apology,* 29-30, in Hogan, 1999). Hogan continues to emphasise the *actions* and teachings of Socrates, recorded in Dialogues, to be his life's work, his '*telos*', (aim or end). Hannah Arendt (in Sennett, 2008, p. 7- 8) in her book *The Human Condition* (1958) notes that, 'A life without speech and without action is literally dead to the world.' According to Hogan (1999, p.25), 'the significance of Socrates' work for education lies essentially *not in any method*, but rather in a *particular kind of conviction*'. His conviction was that by dialogue, discussion, conflict, actions and questioning, humans could learn to understand their lives and their places in the world, seek to improve their conditions of life and work, and learn how their lives 'ought' to be lived.

Sennett believes that humans have the ability to change their lives and their world 'if we better understand the making of things' (Sennett, 2008, p. 8). Plato, the student of Socrates and the writer of the dialogues of Socrates, shared his mentor's belief that the main aim of education is, 'to produce a corps of philosopher rulers in whose hands the supreme power of the polis would be placed' (Hogan, 1999, p. 33). However, both philosophers differed in their views regarding how this should be attained. Socrates believed in liberal personal quests whilst Plato believed in 'obedience to the prescriptions of the philosopher rulers….to attain an unblemished vision of the Good'. In Plato's, theory of Forms, also known as the theory of Ideas, Plato introduces his denial of the reality of the material world and the view that it is only a copy of the real world consisting of two kinds of things; the apparent world of material objects which can be grasped by the senses and is constantly changing (variable) and the unchanging (invariable) and the unseen world of Forms comprehended by reason. In his most famous work *Republic,* Plato establishes himself as an accomplished provider of a 'grand doctrine, which includes theories about the human soul, the nature and purpose of the arts,' (Hogan, 1999, p.34). Plato argues that such understandings are all attained through metaphysical *theoría* (a way of being

concerned with eternal principles) and written in his 'Forms'. Plato advances metaphysics as 'the highest form of knowledge' and attests that through it humankind will attain the ultimate truth. He sought to present humanity with 'a fully adequate account of the nature of human beings, of knowledge, of justice, of politics, of art, of religion and, not least, of education.' (Hogan, 1999, p.34). Plato contributes three main facets to Western concepts of knowledge which are:

> '[Firstly] a hierarchical division of knowledge into a *higher and spiritual* world and a lower *sensual* world, secondly the claim that the higher of the two worlds was one of changeless truths while the lower was one where illusions and unworthy arts featured largely among the accepted cultural pursuits; thirdly the claim that the higher truths whose source was the changeless Idea of the Good were attainable only by the strictly disciplined and properly tutored 'eye of the soul'. (Hogan, 1999, p.36).

According to Plato ideas, or idealism, represent reality and that there is an 'objective truth' held in the unchanging world of the Forms. For both Socrates and Plato ideas are an innate part of the human psyche and physiology and ideas can be drawn out and developed by *discussion and guiding questions*. In many ways the ancient concept of apprenticeship follows this path as a guiding mentor or master craftsman will lead, guide, inspire and evoke an apprentice to develop their own craft knowledge as they become their 'own version' of a skilled crafts person. Plato and Socrates, and later Descartes, concur when they argue that mental prowess is superior to physical activity. Descartes' theory of Dualism, the separation of mind and body, where mental activity is elevated above physical activity is premised upon the teachings of Socrates and Plato. Dunne (2005, p.155) is hugely critical of this division which he describes as, 'the wholly distorting split between mind and body'. Dunne notes that this, 'baleful influence of Descartes' as being one of the main reasons for the lack of strong tradition in the Irish educational system in crafts and trades. Yet, despite their critics, the work of Plato, Socrates and Descartes continue to have their place in the development of the modern educational system in the Western world. Descartes' 'thinking and systematic doubt' philosophy, where everything in the world has to be questioned until no doubt of its truth remains, leads the way for sceptical thinkers – the humans who question and do not accept a 'truth' until it can be proven. These traits can be either rebuked or revered in society today as 'questions' have the power to open doors to discussions and disagreements. They can acknowledge intellectual freedom of speech, query different ways of thinking and create a respect for new ways and means of arriving at solutions based on logical and predictive methods. Freire, (2004, p.37) refers to educands (learners) as 'critical "significators", as they come to realise through the acquisition

and developments of knowledge that they are 'cognizing subjects, and not as an object upon which the discourse of the educator impinges', arriving at this reasoning on the part of the learner is according to Freire, 'the great political importance of the teaching act. It is the creation of a person who can now become an active participant in a political life – a personal life and a life of value'. Yet, their philosophies fostered many questions such as 'how do we know what we know' and 'what is the role of the senses in the development of knowledge?'

For Aristotle good practice stems not from a theory but from reflection on the characteristics of the practice itself, the combination of circumstances blended with the types of goodness which Aristotle advocates as goodness of intellect and goodness of character, 'intellectual goodness is both produced and maintained mainly by teaching and therefore experience and time are required for it' (Nicomachean Ethics, 11 i). From this teaching by Aristotle, Hogan (1999) draws attention to how the ancient philosophy of situation, beliefs, attitudes and practices to which a learner has been inducted is the formation of personal moral identity and *ethos* or ethical standing. Apprenticeship, situated in workshops or college classrooms delivers the same set of circumstances today as that which existed in ancient Greek discussions by providing education through practical engagement. However, in contrast to what Aristotle writes on the theory of practice, he believed in the hierarchical divisions of schooling to be followed by the youth of the *polis, and* states that there were certain things they should not learn such as the skills that require mechanical prowess as they have 'a deleterious effect on the body's condition' (*Politics* V111, iii, in Hogan, 1999, p.39) and are unworthy of the dignity of a citizen of the *polis*. Aristotle gives a low standing to crafts and trades, referring to them as 'necessary occupational subjects' (*ibid* 1999, p.39). Walsh (in Hogan, 1999, p.45) attributes this viewpoint to 'Aristotle's social position, rather than anything of philosophical principle' as Aristotle fails to value, appreciate or merit the crafts and technical activities of the time, in contrast to Plato, who advocated the physical, the bodily and the material in his metaphysical Forms.

However, Aristotle does mention *techné* and he holds that a different type of technical knowledge is required with crafts and trades. This is drawn from remarks in the *Nicomachean Ethics* (VI 4, in Mendelsohn, 2024) where he describes this knowledge as that required for the construction of a house (Nic. Eth VI 4, 1140a4). In this construction, a craftsperson begins with the form of a house in mind, has a desire to bring it about combined with the practical knowledge to build it until and ultimately arrives at the actual presence of a house. It follows that, even though he does not wish to have the elite of the polis perform the actual work, he acknowledges the presence of a specific knowledge in the *'knowing how'* of the craftsperson which he qualifies by stating that a person with craft must know the 'true prescription'

pertaining to the practice (Nic. Eth. VI 4, 1140a21, in Mendelsohn, 2024). Such general truths would include items such as material required, order and design of the building and even if an experienced builder they may not have the character to bring about a house in the best or most positive way. Aristotle always seeks to identify the way in which a process leading to a better life *ought* to be lived – a view all of the ancient philosophers shared though each prescribed or advocated different means to achieve their goal of an improved society.

The following is an explanation of the key terms and Greek words used by the ancient philosophers to describe the different forms of knowledge such as *Poiesis, Praxis* and *Theoria* which in turn have corresponding words of *Techné, Phronesis and Sophia*.

Poiesis, from ancient Greek means the process of emergence of something that did not previously exist or a 'rational goal directed activity of making' in circumstances where the desired end is known (Stanford Encyclopaedia of Philosophy, 2024). Crafts and trades have a significant place in *poiesis* as they engage with a type of knowledge called *techné* which is concerned with things and principles of production. Heidegger (1977, p.4) states that, 'according to ancient philosophy, 'the essence of a thing is considered to be *what* the thing is' and by means of an example of *poiesis*, uses the four causes inherent in *poiesis*, to show the *essence* of a silver chalice as follows:

> (1) The *causa materialis*, the material, the matter out of which for example, a silver chalice is made; (2) the *causa formalis,* the form, the shape into which the material enters; (3) the *causa finalis*, the end, for example, the sacrificial rite in relation to which the chalice required is determined as to its form and matter; (4) the *causa efficiens*, which brings about the effect that is the finished actual chalice, in this instance, the silversmith. (Heidegger, 1977, p.6)

From this example of *poiesis* Heidegger arrives at the conclusion that *techné* is a mode of revealing and has a place in making the finished work present. He continues to call creative action a 'bringing forth' a '*Her-vor-bringen'* (Heidegger, 1977, p.10). In this philosophical view all art, crafts and trades can be viewed as being *modes of revealing* beginning with raw materials and producing or bringing into being something that previously did not exist. Heidegger continued to uncover the primal nature of 'Being' and he uses the German word for 'existence' which is 'dasein', to form Heidegger's ontological concept of '*Dasein'.* A concept which describes the event of a person who is constantly engaged in the world, cares for the world and through their projects are part of *Being-in-the-world.* Heidegger says, 'We have to clarify for

ourselves what it signifies that man has a relation to the works that he produces.' (Heidegger, 1995, p.117).

Praxis, is the process by which a lesson, theory or skill is enacted, embodied, realised or applied. Praxis may also refer to the act of engaging, applying or practising ideas. It is the process of using a theory or something learned in a practical way (Cambridge Dict., 2024). Freire (1972, p. 52) describes praxis as, "reflection and action upon the world in order to transform it". He argues that it is not enough for people to study the world, they also have a responsibility to act to create a better world.

Theoria, from the ancient Greek word for thinking is assigned with Poeisis (making) and Praxis (doing). The activity of theoretical wisdom is what Aristotle calls contemplative study (theoria); he has in mind the study of subjects such as metaphysics, mathematics and natural science. In his view, the activity of contemplating these subjects is the finest activity for a human being. It is the activity of the most divine element or part of a human being

Phronesis: Aristotle uses the word phronesis to describe the type of wisdom or intelligence concerned with practical action. It is distinct from the production of goods or the formulation of a product as it is based on good judgement and excellence of character and habits. Practical wisdom, or phronesis, requires a person to have all the virtues so as to be sensitive to the demands of not only the end goal but the means to achieving it with virtue (Nic. Eth VI 13, 1145a1-2, in Mendelsohn, 2024). It calls for the person to have the ability to navigate between what is right and what is right under the prevailing circumstances which may result in two distinct and separate actions. It is a *higher form of wisdom*, rising above the actual achievement of attaining a goal, but in so doing brings together the good and ethical ideals of a good and virtuous life'. Carr (2005, p. 39) places Aristotle's two modes of non- theoretical reasoning as follows: a) *Techné* (technical reasoning) containing *Poiesis* – 'the value free 'means-end' reasoning where the end can be clearly specified in advance of and hence known prior to and practical means to produce it', and b) *Phronesis* (practical reasoning) or how to act in a morally appropriate way when presented with situations where the action itself is called *praxis*. *Phronesis* is a 'moral intellectual virtue rooted in a natural human capacity' which is 'to do the right thing in the right place at the right time in the right way' (McIntyre, 1981:141, in Carr, 2005, p. 39). Gaining *phronesis* requires experience, according to Aristotle who wrote that:

> ...although the young may be experts in geometry and mathematics and similar branches of knowledge (*sophia*), we do not consider that a young man can have Prudence

(*phronimos*). The reason is that Prudence [*phronesis*] includes a knowledge of particular facts, and this is derived from experience, which a young man does not possess; for experience is the fruit of years. (Aristotle, VI. 8-5 1142).

2.1.3 The Modern Philosophers

The demise of the Greek and classical traditions of practical philosophy and the beginning of modern philosophy can be attributed to the rejection of Aristotle's philosophies in the seventeenth century and the rise of 'Descartes' search for the *a priori* foundations on which certain knowledge could be erected' (Carr, 2005, p.40). Descartes brought about a change in thinking away from the concepts of the ancient Greeks, and in doing so he brought philosophy back into the realm of Western thought creating debate, acceptance and opposition to his writings and theories but achieving active engagement in the pursuit of keeping philosophy alive and pertinent to the human search for improvement in many fields of the sciences, environment and culture of humanity. In his philosophical essay *Discourse on the Method* (1637) Descartes devises a method for discovering truth in any situation by his methodological stripping down of its component parts and assembling them together again but if there is doubt at the final conclusion then the entire concept is rejected. This became known as Cartesian Doubt and methodological scepticism. His famous theory was based on the Mind-Body Duality problem where he believed that the mind and body were closely linked but were distinct entities. Descartes' theories are rejected by many philosophers today, including Joseph Dunne (2005, p.155) as mentioned earlier, who blames Cartesian theories for the 'baleful influence' on the lack of practical craft skills teaching in Irish schools. However, Descartes put forward theories which prompted debate and led to the foundation of many schools of thought within philosophy in later decades. As the conversation grew so too did the fields of thought surrounding practical philosophy such as Idealism, Positivism, Empiricism and Pragmatism and more, all leading to establishing a place for philosophy in the sciences, law, medicine and education.

One of the most important influences on the philosophy of education and the pursuit of knowledge in the 20th century was John Dewey, the philosopher, psychologist and educational reformer. Dewey was a leading proponent of the American school of thought known as *Pragmatism* and in his letters to the humanist, Corliss Lamont in 1961 in Columbia University, he describes himself as follows:

> "I have come to think of my own position as cultural or humanistic Naturalism..... Since it is a philosophy in question and since philosophers from the time of Aristotle-and before-have used the word 'Nature' in a fundamental sense.' (Lamont, 1961).

Dewey rejected the dualistic theories of Descartes and those of modern philosophy in favour of the view that showed knowledge *as being an active collaboration between humans and their environments*. This interaction and active collaboration are not done passively or merely from an observational standpoint but requires the mind *and* body to combine, using all the senses, to negotiate a path through life, sometimes manipulating the environment in order for the human organism, involving action, to proceed. Dewey, wrote extensively on education and many other social issues of his time, especially in popular publications such as the *New Republic*. However, the main focus of Dewey's philosophical work was centred on the 'theory of knowledge' or 'epistemology'. The latter term he rejected and preferred the terms 'theory of inquiry' and 'experimental logic' relating to his own work. 'Dewey's approach understood thought genetically, as the product of the interaction between organism and environment, and knowledge as having practical instrumentality in the guidance and control of that interaction which he termed '*instrumentalism*.' (Field, 2024).

Field (2024) describes the five phases in a pattern of inquiry in human problem solving originating from Dewey's *Analysis of Reflective Thinking* (1933) which includes emotion and reason beginning with; the *feeling* of something amiss or a doubt the *problematic* situation where the human organism is prevented from continuing the fulfilment of a need or a desire, the *reflective phase* engages with the cognitive elements of inquiry (ideas, suppositions, theories etc.) are imagined as *hypothetical* solutions to the problem, the *process* involves the use of *reason* to isolate the subject matter surrounding the initiation of the situation and can be iterative and the final phase is the employment of the solutions through *action*. Dewey's inquiry pattern is not linear, or to be followed exactly but it does provide a schema of how thinking unfolds in the rational empirical sense (Hildebrand, 2024). The process when reconstructed is no longer human thought but is part of the existential circumstances of human life. Dewey viewed the 'arc' as ignoring pre-determined aims and showed the fallibility of looking at results without first looking at the other components of human conduct such as instinct, curiosity, perceptions, emotions and conscious thought and as a pragmatist Dewey accepted the *fallibilism* which was characteristic of this field of philosophy. This viewpoint argues that any proposition deemed to be 'knowledge' is provisional and is accepted only upon its basis in providing relevant understanding of the world as the foundation for human action (Field, 2024).

In *How We Think* (1910, p.67) he wrote of truth as a statement of things, 'as they are' not in a void but in a shared progressive experience such as a friendship or having things in common with fellow humans. He suggests that 'genuine freedom, in short; is intellectual; it rests in the trained power of thought, in ability to 'turn things over', to look at matters deliberately, to judge whether the amount and kind of evidence requisite for decision is at hand, and if not, to tell where and how to seek such evidence, (Dewey, 1910, p. 66-67). In today's world we would refer to this process as a problem-solving technique and one which can be fostered and learned.

2.1.4 Experience and Mind

Throughout his life's work Dewey developed the concept of 'experience' showing that it was fundamental in rebutting subjectivism in psychology and was central to his accounts of existence and nature. In his book *Experience and Nature* (1929) Dewey contends that the ability to control the dynamics of a situation or process when 'mastered in actual experience constitute tools, techniques, mechanisms etc. Instead of being foes of purposes, they are means of execution; they are also tests for differentiating genuine aims from merely emotional and fantastic ideals' (Dewey, 1929, preface iv). He believes that social interaction affected by communication, through language and other tools, does away with the 'alleged necessity of dividing the objects of experience into two worlds, one physical and one ideal' (ibid, preface iv). This is Dewey's rebuttal of the Cartesian separation of mind and body and is also a criticism of past metaphysical quests for certainty and the appearance of reality. He states that the 'character of everyday experience which has been most systematically ignored by philosophy is the extent to which it is saturated with the results of social intercourse and communication' and that the, 'Mind is seen to be a function of social interactions, and to be a genuine character of natural events when these attain the stage of widest and most complex interaction with one another.' (ibid, preface iv). He constantly stresses the importance of recognising the value of *all aspects of human experience* and viewed knowledge as arising from an active adaptation of the human organism to its environment.

As Dewey's theories on education and human knowledge acquisition spread, a similar growth in phenomenology was being fostered by philosophers such as Martin Heidegger and Edmund Husserl in their study of the objectivity and reality of the world as it impacted on human lived experience. Amongst the most prevalent phenomenological philosophers of the 21st century was Maurice Merleau-Ponty and his main contribution to philosophy is his theory of the role played by human *perception* and how it contributes to knowledge and how humans experience the world. Merleau-Ponty engages with the sciences, especially psychology and cognitive

science, and through their scientific experiments on humans, often brain damaged e.g. the Schneider case, emphasized his theory that the body is the *primary* source of knowing the world (Toadvine, 2023). For Merleau-Ponty, this function lies at the existential heart of becoming human — it is only when we project the world following our various intentions (e.g. practical, cognitive, aesthetic) that the world and its objects take on meaning, 'as a perceptual consciousness, as the subject of a pattern of behaviour, as being-in-the-world or existence' (Merleau-Ponty, 2005, p.409). This theory is in direct opposition to the previously long held view of philosophy that places consciousness as the source of knowledge and opposed Descartes '*cogito*' (from *cogito, ergo sum* – I think, therefore, I am.) to be replaced by the body subject (*le corps propre*) where the essences of the world are existential and mutually engaged with each other (at grips – *prise*) and dynamic. He is placing the body as a mediator between consciousness and the external world denying the 'I think' in place of 'I can' as the locus of intentionality and the primacy of perception where he states, as my own existence is carried by my body, that knowledge-acquiring apparatus.' (Merleau-Ponty, 2005, p. 409).

Merleau- Ponty argues that through human involvement or 'being in the world' the perceiver tacitly experiences all the perspective the object has to offer within the framework of its environment along with potential perspectives. John Locke, in his essay *Essay Concerning Human Understanding*, had stated 'there is nothing in the mind which was not first in the senses' (Smith et al., 2004) to which Merleau-Ponty argued that perception was not the causal product of atomic sensations but it was an active dimension of itself a 'third genus' (Merleau-Ponty, 2005, p.408). Throughout his later works Merleau-Ponty portrays the style of artists as not merely subjective but as historical means of expression that begins with perception. In his final essay 'Eye and Mind' he says it is 'by lending his body to the world that the artist changes the world into paintings' (Merleau-Ponty, 2007, p. 16/353, in Toadvine, 2003). In these words he depicts the artist's perception of the embodied world and how they 'see' through their treatment of colour, depth, line and movement. In the '*Prose of the World'* he notes how language is derived from a more primordial function which was 'genuinely creative, expressive and communicative' and in '*Visible and Invisible'* described literature, music and the passions as 'the exploration of an invisible and the disclosure of a universe of ideas' (Merleau-Ponty, 2007 P. 196-149, in Toadvine, 2003).

The above philosophers Socrates, Plato, Aristotle, Locke, Dunne, James, Dewey and Merleau-Ponty and many more, differ in their views on what constitutes human knowledge and how it is attained and retrieved from the mind for active participation in the real world. History can be

interpreted by humankind, the oppressed and the oppressor, from different and opposite views and perceptions, so too can philosophers' views and theories. The philosopher Daryl Koehn, in reply to Richard Rorty's views on Plato and the inevitable historicity of human life, states, 'all we can ever see and 'know' are shadows cast by an inherited worldview,' (Rorty, 2006, p. 209). However, Rorty's views follow Dewey in his belief that human progress is achieved by, 'realizing that we are better informed and more imaginative than our ancestors' and can 'be freer and happier if we think of ourselves as imaginative self-creators rather than as striving to discover the way things really are in themselves.' (Rorty, 2006, p.210).

2.2 Practice

Joseph Dunne defines the term 'practice' in his work *'What's the good of education?'* (Dunne, 2005, pp. 152-153) as follows:

> '... a coherent and invariably quite complex set of activities and tasks that has evolved cooperatively and cumulatively over time. It is alive in the community who are its insiders (i.e. its genuine practitioners) and stays alive only so long as they sustain a commitment to creatively develop and extend it – sometimes by shifts which at times may seem dramatic and even subversive'.

According to Dunne (ibid.) there are standards of excellence within a practice which are in constant states of 'redevelopment and redefinition' by both current practitioners and those who aspire to become practitioners in the future. Dunne includes in his range of practices many examples extending from cabinetmaking to rearing a family, from farming to chess and from soccer to weaving. In this way he illustrates the full range of human to human interactions in all walks of life and in everyday ventures within society that warrant description as a practice. Dunne goes on to point out that engagement fully within a practice requires the tasks of the practice to challenge and benefit the practitioner not only in the successful competent completion of the process but also in the acquisition and development of the moral qualities that transcend it. The striving to attain the best outcome within a practice, for Dunne, embodies the moral qualities of, 'honesty, and humility (in admitting the shortcomings of ones' attempts) as well as patience and courage in sticking at a task.....and a sense of justice and generosity in cooperating with others in projects that require a kind of partnership which overrides the rivalries of individuals' (Dunne, 2005, p.153). Dunne calls these qualities the, 'internal goods' of a practice and distinguishes them from the external goods which overlap practices such as, 'money, status [and] reputation'. Dunne credits his definition of

practice on the work of McIntyre's *After Virtue* (1981) and Carr's *'What is an Educational Practice?'* (1987). Richard Smith (1995) in his review of Dunne's 1993 book *'Back to the Rough Ground: 'phronesis' and 'techné' in modern philosophy and in Aristotle'* quotes Dunne as describing a practitioner as someone who, 'is constituted through the actions which disclose him both to others and to himself as the person that he is' (Dunne, 1993, p. 263, in Smith, 1995, p. 213).

Carr, (1997, p.164) describes how the modern version of an educational practice begins with the recognition that, 'our contemporary concept of educational practice is the end-product of an historical process through which an older, more comprehensive and more coherent concept has been gradually transformed and changed. Ryle presents an argument stating that since one cannot 'know that' something is the case unless one already 'knows how' it stands that 'knows how' is prior to 'know that' and as Ryle states 'practice is not the step-child of theory' but is the reverse and is shown as, 'efficient practice precedes the theory' of it. (Ryle, 1949, in Carr, 1987, p.165).

Carr argues that 'practice' has such a plethora of meanings that the search for criteria which can provide a concept of educational practice with a definitive meaning presupposes it has unity and simplicity which it does not have as practice is not defined by its relationship to theory and that practice is not a 'stable and static concept where any philosophical analysis of it meaning, its history, will only be of incidental or antiquarian interest' (Carr, 1987, p.166).

2.2.1 A view from History

With reference to 'antiquarian interest' Carr argues that it is only through history that an appreciation of why education in now construed as a 'practice'. The Greek word 'praxis' he notes, does not completely translate to our term 'practice' as its conceptual structure puts practice as a distinctive way of life – a life devoted to right living through the pursuit of the human good. It was different from a life devoted to '*theoria*' – the contemplative way of life of the philosopher or scientist. The ancient Greeks used the terms *praxis* and *theoria* (practice and theory) not just as a means of distinguishing knowledge and action, thinking and doing, 'knowing that' and 'knowing how' but as two different socially embedded human activities. However, good deliberation is dependent on *phronesis* or practical wisdom, the most valued and supreme intellectual virtue of knowing, the knowing 'when' and 'how' to apply phronesis in a particular situation demands the experience and knowledge of a wise practitioner. *Phronesis* is the combination of good

judgment and action. Dunne (2005a, p. 375-376,) in '*An Intricate Fabric: Understanding the Rationality of Practice'* outlines the key features of phronesis that have to do with,

> '... its role, a role as an action-orientating form of knowledge, its irreducibly experiential nature, its non-confinement to generalised propositional knowledge, its entanglement (beyond mere knowledge) with character, its need to embrace the particulars of relevant action-situations within its grasp of universals, and its ability to engage in the kind of deliberative process that can yield concrete, context-sensitive judgements.'

Dunne refers to his deliberations as 'neo-Aristotelian' in his argument against the use of technical rationality in the course of creating good educational practice. He emphasises that 'significant human goods are not achievable by any system, bureaucratic or otherwise' (Dunne, 2005a, p. 382) and that the practice of education is not just a view of 'the practitioner' constructing the practice but 'there is a stronger sense in which the practice constructs the practitioner' and where the collective goods and standards of other practitioners set 'the horizon' and 'establishes the practice as a collective and communal space' (Dunne, 2005a, p.382). Dunne's love of philosophy, the philosophy of education and the human spirit is evident in his appeal against bureaucratic statistical research in education stating that the stories, the characters, the significance of episodic engagements, the communications, the sense of belonging to a community within education and practice is in itself a fount of knowledge where successes and failures of projects and schemes can be utilised for further development of policies and direction. He concludes his writing on practice as follows:

> 'It was Aristotle himself who long ago suggested in the Poetics that drama and story can instruct and move us precisely because, in their depiction of particular cases and characters, they reveal – without necessarily stating or explaining – universal themes. And in this, as in much else, perhaps contemporary theory of the practical can still learn from 'the Philosopher' (Dunne, 2005a, p.386).

Following on from Dunne's vision of educational practice being a, 'collective and communal space' Kemmis and Grootenboer (2008, p. 2) state in '*Situating Praxis in Practice'* that, 'The relationship between the individual and a state, society, culture or class is one of mutual constitution: .....[and] as human beings and especially as persons with human agency, we are constituted through our relationships with others – culturally, socially and economically.' Amongst others we find our 'selfhood' where we

share language (sayings), activities and practices (doings) and we become part of groups, families, and occupations (relatings). These 'sayings', 'doings', and 'relatings' constitute our lived relationships others, become ingrained in our experiences and we adapt to fit into a, 'cultural, discursive, social and material world' as if it was waiting for us to participate in its development (Kemmis and Grootenboer, 2008, p2). The authors continue to outline how teaching practitioners, as individuals, and as part of the educational practice should have dispositions following Aristotle's teachings and be: 1) well informed (*episteme*) and put knowledge into practice by theories *(theoria*); 2) have the technical skill to achieve educational aims by appropriate means (*techné*) which are put into practice by action (*poiesis*) and 3) aim to act prudently (*phronesis*) with practical action (*praxis*). Kemmis and Grootenboer added another disposition to the three mentioned above which they refer to as a 'critical disposition' or 'knowledge constitutive interest', guided by the *telos* (aim) of overcoming irrationality, injustice, suffering where the subsequent action is referred to as 'emancipatory action'.

2.2.2 Society, Economics and Culture

These good intentions, and actions drawn from them, are not enough to constitute a good educator as Karl Marx said in his '*Theses on Feuerbach*' (in Kemmis and Grootenboer, 2008, p.3.), 'changed men are products of changed circumstances and changed upbringing, ... that it is men who change circumstances and that the educator must himself be educated'. The educator, teacher or mentor in this view is seen as a product of their own circumstances and experiences which has come about by others' circumstances and experiences in the evolution of policy, theory, conformity or constraints on the individual's practice. These properties have arisen from the collective knowledge of groups, professions, and many other types of groups, and are 'codified in the form of theories and traditions' and 'carried in culture and discourses' within the groups through time (Kemmis and Grootenboer, 2008, p.4). Learning through encounters with experienced individuals (as in apprenticeship) leads to the development of the dispositions above and occurs in a 'sea of discourse' (ibid, p.4) where the world is offered to the educator and the educand through everyday language, through the specialised discourses of different fields of science and the arts and through continuous shaping and reshaping of problems old and new with new technologies, ideas and skills.

The dispositions of episteme, techné and phronesis are continuously being developed and formed through *cultural and discursive activities* such as reading, writing, speaking, listening and all forms of interactive communication in physical proximity or through

modern technologies i.e. internet software, films, videos and music. The dispositions are also influenced *socially* by family members, friends, peers and mentors.

The forces of *economics and materials i*nfluence the dispositions of humans as they encounter difficulties with economic conditions of poverty, hunger and lack of medicines. In other words practices are *culturally, discursively, socially and economically* shaped and formed. They are situated in a particular place and time as they occur. How a practice evolves is dependent on the history and experiences of the people involved. Practices for their continued survival and existence must remain fluid, open to new ideas, courageous in challenging outdated or morally constraining modes of behaviour or action and above all be inclusive, diverse and equitable in the pursuit of their main aims in changing times and a developing world.

The cultural-discursive, material-economic, and social-political dimensions seen in Fig. 3 shape a practice and are referred to as the *practice architectures* of that practice (Kemmis & Grootenboer, 2008, p. 57). 'While practices are mediated by practice architectures, practice architectures are also mediated by practices.' (Mahon et al., 2017, p.10). Rather than being fixed or stable, practice architectures evolve in response to various kinds of natural and social forces, and through human intervention (Kemmis, Wilkinson et al., 2014, pp. 4-5), including through practitioners' ongoing individual and collective practice. (Mahon et al., 2017, p 10).

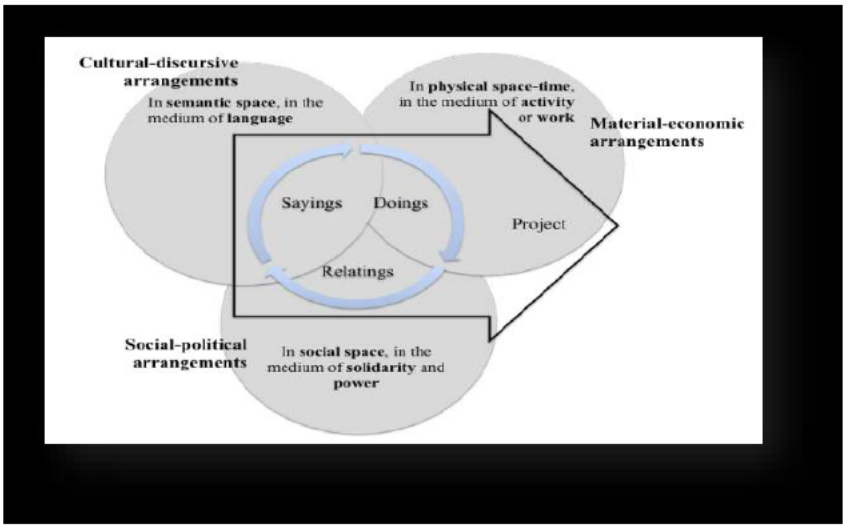

Figure 3: The three dimensions of Practice Architecture (Kemmis & Grootenboer, 2008, p. 57)

Schatzki (in Kemmis, 2008) based his view of practice as 'the site of the social' offering a concrete and material form to Wittgenstein' notion of forms and language. The 'bundles' of sayings, doings and relatings form the settings for everyday life and learning where

language is part of the 'game' of understanding and agreement between people. He based his view on practice through his observations of the Shaker religious sect's preparation of herbal medicine and its division of time, space and labour in a social milieu. (Mahon et al., 2008).

2.2.3 Communities of Practice

The singular element necessary for discourse within a practice is that participants must share a sufficiently common background knowledge of a topic to be able to agree about something in words. This knowledge is the essence of learning a skill or serving an apprenticeship in any field of expertise or educational setting from medicine to carpentry and from science to the arts. The common language *within* a practice is learned through experience, listening and watching more experienced others and by emulating the rules and constraints of the practice evolved through envelopment in its history, settings and time. Another view of practice is based on *the individual* in the form of Lave and Wenger's concept of how individuals develop knowledge and identity in *communities of practice*. Cognitive anthropologists Jean Lave and educational theorist Etienne Wenger coined the term "community of practice" when studying apprenticeships (apprentice tailors) as a learning model in their 1991 book *Situated Learning*. The term referred to the community that acts as a living curriculum not only for an apprentice but also for those surrounding them. Learning occurs in a 'participation framework' not only in the mind of the participant but also as part of the community. The learning occurring in the community of practice is dynamic and inclusive based on three main characteristics of: *Domain*, *Community* and *Practice*. 'Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly' (Wenger-Traynor, 2024). Writing this definition Wenger-Traynor has effectively posited three interlocking features of a community of practice in one sentence: 'share a concern' is '*Domain*', 'something they do' is '*Practice*' and interact regularly is '*Community*'. Their relationships are built on their willingness to share and help each other and their caring for their domain. Artists, writers, architects, plumbers, electricians may not work together, and often work alone, but within a community of practice they will meet to share their experiences and knowledge; *Practice:* members of a community of practice are not just interested in talking about their experiences or work but are practitioners who share their experiences through stories, materials and tools and are involved in a shared practice which is continuous and dynamic. It contributes to a collective sharing of knowledge and practices, sometimes informal, but always

continuous and a source of learning. Lave and Wenger (1991, p. 94, In Kemmis and Grootenboer, 2008, p. 8) put forward a 'decentred' understanding of education where the learner actively participates in a community of practice. They state that, 'understanding that mastery resides not in the master but in the organization of the community of practice of which the master is a part'. This statement would support the fact that a framework of collaboration and co-operation is essential for a healthy and progressive apprenticeship training system to be re-imagined in modern times and to include the participants and masters as active agents in the discursive process. It is a system which is inclusive of the practices' aspirations of craft and trade mastery apprentices are introduced to practices and become worthwhile and valued participants of society. Nielson (2010) presents specific features of learning processes which occur in an apprenticeship as: learning in a community of practice, learning through participation in practice, bodily learning and imitation and learning through assessment of practice.

The fact that apprenticeship is referred to as a 'dual' framework where sites of learning are spread over two distinct environments (the educational institute and the worksite, office, studio, factory etc.) is not conducive to the fact that an apprenticeship is a 'singular state of learning' for *the apprentice*.

2.2.4 Learning through Participation and Imitation

Apprenticeship learning in the 'dual' system of workplace and educational institution requires the apprentice to become part of two *communities of practice*. Each dealing with the relationship between different forms of knowledge and concepts of practice in different ways.

a) In the workplace, which is usually an area totally dedicated to the production, maintenance, servicing, creation or preparation of materials and goods, the apprentice learns to complete tasks within a multigenerational workforce with its own particular rhythm and language where the main purpose is the successful continuation of production or service. The education and training of the apprentice may often fall to one mentor or instructor to demonstrate tasks and over time there can be a variety of mentors if the apprentice is working in a large facility with different departments, materials and resources.
b) In an educational environment the emphasis is on the learner, situated in classes or designated work areas, with peers at equal stages of learning, where course work is presented in a structured, scaffolded format with professional educators and a curriculum designed for purpose. Both communities of practice have different social,

environmental and educational methods with varied means and modes of presenting the learner with the opportunity to engage in the process.

Learning through participation in practice occurs in the workplace when tasks are presented to the learner on a daily basis until learning occurs. The practice is often initiated by instruction, without the necessity of a theoretical background, and is often different from an educational institution where theory and principles are, for the most part, learned first before the learner is required to put the learning into practice. Nielson (2010) emphasises the role played by 'responsibility' in the workplace environment as the apprentice takes ownership of the completion of the tasks assigned and by doing so becomes part of the larger workforce who will come to rely on the apprentice's success and engagement in the finished process. The learning process is complete when the apprentice demonstrates competence in fulfilling the assigned task and is assigned more complex tasks on a ladder of increasing responsibility. This usually involves tacit implicit knowledge as each stage demands more skilled and responsible actions from the apprentice in what Lave and Wenger (1991) described as a 'learning curriculum'.

Bodily learning and imitation in apprenticeship is most often based on daily routines which become part of the apprentices actions as they become familiar with their bodies interaction with tools, materials and machinery. The body is the source of learning. The movement throughout the workplace, the position of tools and equipment (from pens to drills) on workstations, the placing of objects within reach for easy and safe access, are all part of the apprentice's bodily learning which is founded in the mind-body or embodied mind theory which totally refutes the beliefs of Descartes' theory of mind-body dualism where the mind and body exist in separate categories. Gilbert Ryle in his 1949 book *The Concept of Mind* states that Descartes made a' big mistake…a category mistake' (Ryle, 2009, p.6) as the body and mind are intertwined and inseparable. He refers to the theory as follows: 'Such in outline is the official theory. I shall often speak of it, with deliberate abusiveness, as 'the dogma of the Ghost in the Machine'.' (Ryle, 2009, p.5). The term has evolved to become synonymous with science fiction and the possibility of an emerging consciousness within computers but was coined by Ryle as a critique of Cartesian mind-body dualism. Lakoff and Johnson, (1999, p, 17) in their book *Philosophy in the Flesh*, argues:

> "These findings of cognitive science are profoundly disquieting in two respects. First, they tell us that human reason is a form of animal reason, a reason inextricably tied to our bodies and the peculiarities of our brains. Second, these results tell us that our bodies, brains, and interactions with our environment

> provide the mostly unconscious basis for our everyday metaphysics, that is, our sense of what is real…….. Our sense of what is real begins with and depends crucially upon our bodies, especially our sensorimotor apparatus, which enables us to perceive, move, and manipulate, and the detailed structures of our brains, which have been shaped by both evolution and experience."

Sennett (2008) in his book *The Craftsman* devotes separate but interlocked chapters on The Workshop, The Machine, The Hand and Arousing Tools. The chapters are rich in philosophical histories and stories of human engagement with the world through the senses of smell, taste, touch, hearing and sight and the part played by the raw materials of the earth, when in the hands and minds of humans, are transformed into wonderous (and sometimes terrifying) feats of creation and invention. From substances such as clay, stone, wheat and uranium, humans have created a world of glass making, cooking, sculptures and atomic power. From small workshops and common tools the embodied human mind has used its power to create beauty and danger – its own Pandora's box.

The engineer and writer Mike Cooley (2013) remembers the images of craftsmen working in the small Irish town of Tuam in Co. Galway, his birthplace, in his poem '*The Grand Tour, Images of Craft Skills in 1940s Tuam'*. He evokes the sense of embodied mind as the 'artists/craftspeople' used their 'embodied knowledge' in the lines:

'It was a place of unselfconscious artists/craftspeople
whose embodied knowledge is that marvel, human
skill
which causes inert tools to spring into life as biddable
extensions of the knowing hand, producing art concealed
as work which always revealed the hand of the
maker.
Where tools and materials supported those, skilled with
talents fine-tuned over centuries
and whose tacit knowledge and sense of quality
lurked in unpretentious work spaces.'

Figure 4: Excerpt from 'The Grand Tour, Images of Craft Skills in 1940's Tuam' by Mike Cooley (2013)

The final part in an apprentice's learning journey is the learning through *assessment of practice*. It is the time before becoming a 'master' or 'journeyman' where assessment of skills, acquired over time, are frequently assessed to gauge progression and completion in line with acceptable

standards. Sennet (2008) adds three human' expressive directions' to the arrival at the point where the undertaking of a task/craft/apprenticeship is reached – where the use of expressive tools have guided the craftsman to reach or attain a goal (not necessarily the end of the road) but a stage or step on the ladder and these are, 'sympathetic illustration, which identifies with the difficulties a neophyte encounters; scene narrative which places the learner in a strange situation; and instruction through metaphor, which encourages the apprentice to reframe imaginatively what her or she is doing'. He stresses the use of 'imagination' in the 'use of tools' and 'in labor, as in love, progress occurs in fits and starts.' (Sennett, 2008, p.238). The progress of learning in an apprenticeship is varied especially if the apprentice is 'serving two masters' which can often occur within the workplace and in the dual system between the workplace and the educational institution. Sennett (2008, p.238) offers wise words when frustration and failure loom in the pursuit of a craft and skill, he says, 'we are complex organisms' and it is through perseverance, practice and observance of the expressive tools, 'the more that person will gain the craftsman's emotional reward, the sentiment of competence.'

2.3 Curriculum

In a vocational education context, where the design and development of a meaningful curriculum for apprenticeship requires collaboration between educational institutions and employers, there is a danger that the vocational courses are reduced and commodified focusing narrowly on producing a specific skill set for particular jobs or single employers. This reductionist positioning of knowledge and training are seen as *modes of capital* and result in, 'commodifying the potential of human beings' (Duckworth & Smith, 2018, p. 530). Hyland in his work, *Theory, practice and performance in teaching: professionalism, intuition and jazz* (2002, p.5), raises awareness of 'the commodification of professional knowledge' and the 'marketisation' of education with 'the rise in prominence of competence and outcome-based strategies'. While Duckworth and Smith discuss skills training at the apprenticeship level in further education and Hyland focuses on the professional development and training of teachers at higher education level they are all concerned about the commodification of knowledge purposely built for 'employability'. The above authors highlight the fact that these 'market value' strategies overlook the importance of human value and virtue and do so without consideration to the main aim of education which is, through the instrument of the curriculum, to create and enhance the human condition and lived experiences of humanity within a structured caring society. With these human values in mind, the central question becomes: how should a curriculum for apprenticeship be designed and developed? To address this I now consider critically how curriculum theory and design have been defined, evolved and been adapted in

educational settings and in particular how the future development and implementation of vocational curriculum content can be enhanced by the inclusion of the Arts, modern educational technologies and practical real world teaching methods of project and problem based learning activities.

2.3.1 Curriculum Design and Development Definition

The word 'curriculum' is derived from its Latin roots meaning 'a running', 'a race' and 'a course' with secondary meanings of a 'racecourse' or a 'career' (Egan, 1978, p.66). Egan describes how the Roman statesman and philosopher, Cicero, used the word curriculum to describe both 'content' and 'temporal' meanings in his writings. Slattery (2017, p.184) defines, 'curriculum as a process rather than simply an object', which is constantly evolving and never a static phenomenon. This view of fluidity and continuum is supported by Gardner who notes that every period of history has its own foremost statements or principals of explanation (Gardner, 2011, p.14) and the subsequent links to the past are eloquently described by James Joyce in his novel *A Portrait of the Artist as a Young Man* (2000, p. 273) when he states, 'The past is consumed in the present and the present is living only because it brings forth the future'. Eisner, (1979, p. 34 – 35) expands on the term 'course to be run' (*currere),* by stating the perception of the course infers *obstacles and tasks* to be completed and includes a marked beginning and an end. He uses the metaphor of the racetrack to show how education is a, 'preplanned series of educational hurdles and an entire range of experiences'. However, Stenhouse (1975, p. 105) prefers to define curriculum as, 'the curriculum problem' and as such the *problem* becomes one of, 'relating ideas to realities, the curriculum in the mind or on paper to the curriculum in the classroom'. Ornstein and Hunkins (2018, p. 26) state that defining the curriculum is important to provide, 'scope and diversity' within an educational system. They offer several practical definitions of curriculum viewing it as a field of study, a map or a plan of content and timings, a planned and unplanned presentation of experiences and as a selection of subjects offered in specific groups or professions. They present the view of achieving, 'success' in curriculum development as having a, 'plethora of meanings: attaining standards, liberating minds, indoctrinating, opening intellectual horizons, scoring high on tests, [and] knowing the mores of particular cultures.' (ibid, p. 210). The ultimate challenge confronting curriculum designers therefore is to encompass philosophical, social and political views of a contemporary society together with those of the individual learner and groups of learners. Biesta (2009, p. 3) delves further into the concept of a successful or *good* education by stating we must question the content choice placed in a curriculum and question the effectiveness of these choices by asking, 'Effective for what? – and given that what might be effective for one particular situation

or one group of students but not necessarily in another situation or for other groups of students, we also always need to ask, 'Effective for whom?'. Young (2014, p. 7) in a speech at Cambridge titled, *The Curriculum and the entitlement to Knowledge,* asked the following: 'What has happened to the Enlightenment idea that knowledge is the only real source of freedom– freedom from being trapped by one's own experience- freedom as the sociologist Basil Bernstein put it, 'to think the unthinkable and the not yet thought'. Evolving from these questions it appears that the first requirement of either design or development of a curriculum is to determine its *purpose* before assembling and evaluating the content, teaching materials, timetables and matching the aims of the original curriculum design to the practicalities of delivering educational programmes for the betterment of society whilst remaining cognisant of the needs of humans to pursue their own goals, satisfy their own curiosity, develop their own talents and foster the development of each individual's creativity and imagination. Each individual entrant to apprenticeship education comes from a unique and diverse background and it is essential to recognise that the dual system of apprenticeship contains properties that can be enhanced and developed further providing a more inclusive framework that supports not only the whole apprentice as a human being but also all stakeholders involved in the apprenticeship system.

2.3.2 Language and Place

The starting point I present here is founded in the theory of language code researched and developed by the sociologist Basil Bernstein in the 1970s through his work in socio-linguistics, social organisation and education. His work is of particular relevance in apprenticeship education as he developed a theory of how the language people use in everyday conversation, from their home life to their working life and all the conversations in between, reflects and shapes their identity and their belonging to a certain social class and cultural group. He asserts the existence of a direct relationship between language and societal class. In his book *Class, Codes and Control* (2005), Bernstein presents two types of language code which are *elaborated* and *restricted* codes and, 'that forms of spoken language in the process of learning initiate, generalize and reinforce special types of relationship with the environment and thus create for the individual particular dimensions of significance.' (Bernstein, 2005, p.58). He attempts to understand why children of working classes often struggle to learn language based subjects as opposed to middle class children who are successful in attaining higher grades in these subjects. However, the working class child's ability to learn mathematics was on a par with children from middle classes. He deduced that the language of their environments had shaped their learning needs as working class children needed more explicit elaborate coded language

to fully understand, participate and belong in the conversation. A feeling of belonging in a place, speaking the same language, adopting the same speech tone and even accent to those of a learner's peers is of paramount importance to the learner as they strive for successful completion in a programme of study. Bernstein notes in his study that middle class children could relate and understand both codes but working class children deciphered easily the elaborated more explicit code but were at a loss when restricted code was used in teaching materials and methods of teaching. Bernstein described a curriculum as a collection of scientific discourses where the vertical discourse is explicit with 'specialised symbolic structures' (Bernstein, 1999, p.161) such as those found in, 'the specialised criteria for the production and circulation of texts' (ibid, p.159) and the horizontal discourse as, 'local, context dependent' and 'typified as every day or common-sense knowledge' (ibid, p. 159).

However, there is a part of Bernstein's theory that particularly interests me. If, when exposed to a 'new' language of mathematics, the working class and middle class children performed equally well, it would lead me to believe that people from all socio-economic walks of life or 'classes' have equivalent intelligences when introduced to new experiences in the correct manner and to the same extent. This raised the question of whether, the middle class children were exposed to different learning content in their homes and if this content was unintentionally pre-supposed in the teaching materials and methods devised by the school curriculum? The question could then be asked, are all students beginning from the same baseline. The challenge then is to choose content and methods of experiential learning and assessment that can be understood providing knowledge and skill to the apprentice and value to all the stakeholders involved in the apprenticeship process.

The Scottish philosopher David Hume, In *A Treatise on Human Nature (1739-1740),* asserts that decisions made about the direction of education are, 'always and necessarily engaged in value judgements – judgements about what is educationally desirable.' (in Biesta, 2009, p. 2). In other words he opened up the 'is-ought' debate regarding what *is* actually occurring in education and what *ought to be* happening.

2.3.3 The Workplace Learning Environment

The rigors, formalities and expertise of any profession or skill are gradually learned over time from immersion into the deep end of discovery and by successfully completing the tasks and learning opportunities presented by more skilled masters. Apprenticeship places responsibility on the apprentice to complete the specified tasks with knowledge and skill, not only for their own benefit, but also in scenarios where others are dependent on the apprentice's

performance. This dependence can be related to health and safety, job progression, teamwork or renumeration for 'job lots' completed on time, within quality control specifications. The apprentice learns 'on-the-job' and the job is dependent on producing either a service or a product for sale and for profit. Social and emotional skills are learned 'on the job' such as focus, timeliness, diligence, co-operation, collaboration, care and understanding. The social and moral aspects of apprenticeship may sometimes outweigh the cognitive especially in the early stages where the apprentice 'is finding their feet' or 'learning on the fly' and concerned more with 'fitting in' and not naïvely following instructions such as 'get the bucket of striped paint' or 'find the glass hammer'. Eraut (2004, p. 249) states that, 'whilst most people equate learning with formal education and training and assume that working and learning are two quite separate activities that never overlap' the opposite is in fact more accurate. Eraut situates the workplace as a significant learning environment

Dewey remarks, 'One of the greatest educational fallacies is that the student only learns what he is being taught' (Dewey, 1938, in Eisner, 1993, p.222). Apprenticeship learning not only occurs in the classroom or from books, teachers and mentors but also occurs in the spatial environment of the workplace surrounded by the noise of the machines, the smell of the materials, fabrics, chemicals or the feel of the tools being used in whole or part by the human body. Learning occurs through all the senses and Eisner (1979, p. 84) states that 'many of the most productive modes of thought are nonverbal' and 'operate in visual, auditory, synesthetic ways that far exceed the limits of logically prescribed criteria or discursive or mathematical forms of thinking'.

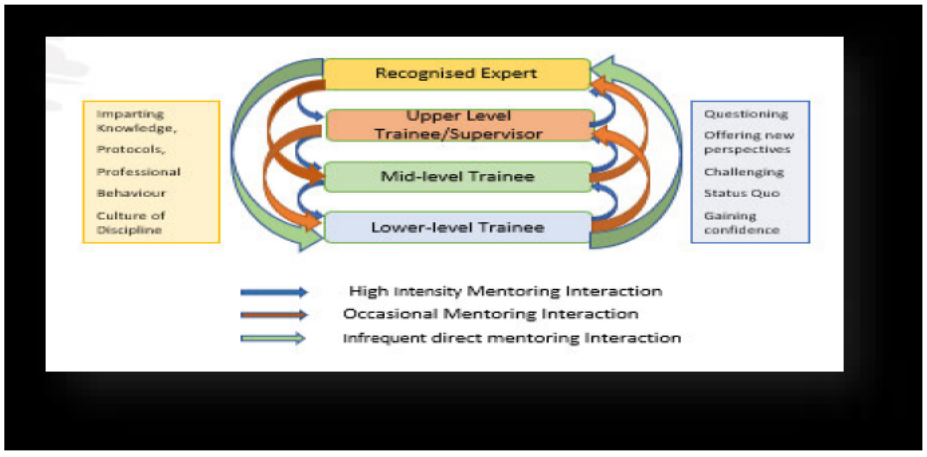

Figure 5: Progressive Mentoring Model (Santora et al., 2013)

In tandem with the physical learning, absorbed through all the senses in a workplace environment, there are also many human-to-human interactions occurring. In a workplace environment the task of *mentoring an apprentice* can be either a single one-to-one relationship

or it can involve a large number of individuals who are master craftsmen or are fellow apprentices at different levels of apprenticeship within a large company or organisation. In large organisations a mentoring ladder, based on Vygotsky's Zone of Proximal Development, and known as a Progressive Mentoring Model proposed by Santora et al. (2013), as shown in Fig. 4. This model allows for individuals at all levels to become part of the mentoring process. It projects a ladder which goes up *and* down – not merely the top-down autocratic version usually portrayed by master/apprentice – and involves other apprentices at different levels of apprenticeship training to interact.

A unique aspect of this model is that even the most junior apprentice can serve a valuable role. Mentoring is also *role modelling* and apprentices (and students) will often find it easier to model behaviour and practices that are close to, but just beyond their own competency and/or experience. Providing such a model allows for interaction between different apprentices from varied departments to interact and learn the language of their profession, the skills yet to be learned and the future progression from one stage to another – their projected road map.

Another initiative which ought to be incorporated into apprenticeship learning is that a mentor/master would undergo short courses in apprenticeship teaching and learn how to develop the rapport necessary for teaching practices involving apprentices. Not all master craftsmen are good teachers. Not all teachers are master craftsmen.

2.3.4 The Educational Institution Learning Environment

Lawlor, (2018) in her study on vocational education and training systems in Germany, France and the UK outlines the dual system of apprenticeships in all three countries ranging from the ages of entry, subjects on offer in the curricula and routes to progression on completion of assessments. Lawlor accredits the success of the German and French industrial market in part to the success of their vocational educational system which in turn is founded on the strength of their school system *as a whole*, from primary to second level, and the provision of a vocational route *or* an academic route for students beginning in second level. In France the split into either an academic educational route or a vocational educational route occurs at 15-16 whilst in Germany the split occurs at ages 11-12. The most valuable element in these splits is that both routes are deemed *equally worthy* and aim at giving the pupils an education best suited to their individual abilities and strengths. In both countries those taking the vocational route (even after age 16) are required to continue with a general education with subjects such as languages, maths, history, geography combined with the applied and theoretical specific skills subjects. Standards of excellence in vocational education are prized in both countries and entry

to third level higher education is available to vocational students by meeting specific college criteria. The basis for such entries to third level is founded on the rigorous standards of the vocational course, completed by the student, including its curriculum and assessment criteria. Vocational education in both countries is founded on the quality of the courses on offer, *rather than the quantity*, enabling students to develop individual potential and transfer to academic routes as they mature and develop competency and confidence in their skill and craft.

Doll (2013, p.220) posits that creating curricular opportunities involves engaging in the conversation for meaningful educational programmes and urges people to, 'to honour the localness of our perceptions and . . . to realize that our local perspectives integrate into a larger cultural, ecological, cosmic matrix'. In apprenticeship education the daily workload often consists of making errors, finding and solving problems and observing master craftsmen at their craft. Errors are expected. They form part of the apprentice's learning using all their senses e.g. touch for heat or cold, hearing for noise or silence.

The current perspective of curriculum design, associated with numerous educational psychologists Behaviourists, Cognitivists and Constructivists since the 1920's, has introduced various systems, frameworks and organisational theories which aim to *transfer* knowledge to learners in structured scaffolded formats. Recognising individuals as cognitive members of society was strengthened by the introduction of Bloom's scientific' model for curriculum design presented in the form of a Taxonomy in 1956 and re-imagined in 2001 when the nouns of the original domains of knowledge (Cognitive, Affective and Psychomotor) were replaced with action verbs designed to enable teachers to plan for a more predictable, controllable, dynamic and engaging learning environment for themselves and their learners in the practice of teaching. Whilst this method is prevalent in teaching and acts as a starting point for the design of curriculum content, it is important to note that this holds up *only* if a linear framework and predictable and controllable learning outcomes are accepted as being educationally desirable.

In a world where curriculum development centres and lays emphasis on cognition and high grade achievement rather than human-centred education, on science and maths rather than art and music, on able bodied rather than those challenged physically, mentally or emotionally, on males rather than females and other genders and on youths rather than on older people or simply those wanting further education for societal progression and fulfilment, there is still a great deal of work to be done. The provision of activities and interdisciplinary engagements offer a development of the whole person, not just the cognitive dimension. The appreciation and participation in the arts and humanities is viewed as of equal importance to understanding

maths and science; where cooperative and independent learning opportunities are offered to promote communication and self-determined participation in problem solving with real world scenarios and where students and teachers have a voice that is effectively heard by curriculum developers and educating partners within a learning community governed by respect and dignity The sociologist and author Patricial Leavy's book *Method Meets Art* (2020) advocates for a new perspective in research, based in the Humanities and Arts, named Arts Based Research (ABR). This new approach to curriculum research and development encompasses all disciplines including the sciences. In the opening pages the author makes a foundational statement claiming, 'The arts can uniquely educate, inspire, illuminate, resist, heal, and persuade. (ibid p. *ix*).

In educational institutions and in workplaces there is always a *planned* agenda for mentoring or a curriculum usually organised by groups of professionals to deal with content matter such as theories and methods in learning a craft or skill but there is also an *unplanned* curriculum which occurs naturally where the dynamics of the environment are open to adjustment. This *hidden* curriculum (Eisner, 1979) which evolves from interactions between students, between students and their teachers and especially between mentors and apprentices, utilises the power of narrative and storytelling in informing and educating those being newly initiated into the craft. These stories, surrounding the craft being learned, are usually about the mistakes, the 'near misses' or the 'almost got it right'. They are not found in text books and often make deep lasting impressions which can be funny, engaging and educational. Narratives, according to Leavy (2020, p. 43), 'have the potential to make us feel connected; open our eyes to new perspectives; stimulate the development of empathy, self- awareness or social reflection'. In essence it is our Humanity – it is what makes humans tick!

2.3.5 The Online Learning Environment

As the world of technology is fast and dynamic, the introduction of new learning and teaching methods and materials to keep pace with these new technologies is an ongoing challenge. The challenge to employers is to attract people with the *ability to learn,* to learn new skills, new techniques and to adapt to new means of production involving modern machinery, lasers, robots, chemicals and systems still under construction or not yet invented. With the rise of Artificial Intelligence (AI) new forms of learning have been introduced into education. The scope of AI covers many diverse areas such as problem solving, reasoning, knowledge representation, learning, planning and decision making. Natural Language Models (NLMs), such as ChatGPT (generative pre-trained transformer), is the much talked about chatbot developed by Open AI and launched into general circulation online in November 2023. It is not a 'new invention' as

developments began in the 1950s, but with the advancement in other technologies and the ability to create large datasets that generate text and respond to a human's queries, feedback and prompts. ChatGPT, Claude and other models have made significant changes to how humans engage with non-human providers of information to include not only text but sound, video and graphics. Whilst the technology has benefits, it is free and easily accessible at any time in any place if connected to the Internet, it poses questions for an established educational system concerned with plagiarism. Learners can use ChatGPT to write their essays, solve their math problems and formulate their code. But if used correctly in education AI has the potential to create critical thinkers, students who learn to disseminate, de-construct and analyse the information received, teachers who use it for best practice and creativity in classroom discussions, workshops and practical and project based real world problem solving assignments. Concerns with copyright, bias, and other moral and ethical issues are of concern also as ChatGPT takes its data sources *without* permission from the authors, is *not* controlled or contained by truth or misinformation and it is *not* beyond making errors. In this AI has ventured into the realm of moral and ethical argument. Hyland (2020, p. 324) quotes Warnock (1967, p. 72) stating that a moral argument, like other arguments 'offers reasons to people, and people are not always reasonable'. The question then is whether society should regulate and control AI systems and their use. Hyland (2020, p.325) concludes his essay 'Telling Moral Tales…' by stating that humans inherit an ancestral lineage as conscious beings which enables us, 'to construct and maintain collective moral convergence and inter-subjective ethical consensus.'

Hyland is correct in stating the fact that today's governments and agencies throughout the world are attempting to arrive at an ethical consensus, however, he does not refer to the timeframe involved. It is a slow process in some parts a scramble to catch up with new technologies and put in place moral, ethical and legal regulations for good practice in using AI in all aspects of our lives from medicine to education and every human-technology scenario in between. The ethical guidelines from the European Commission (2022, p.6) are outlined under a series of headings which are listed below (see Fig. 5) all of which insists on human centred co-operation between teachers, students and parents in the overseeing of use between AI and young students to ensure best practices in use.

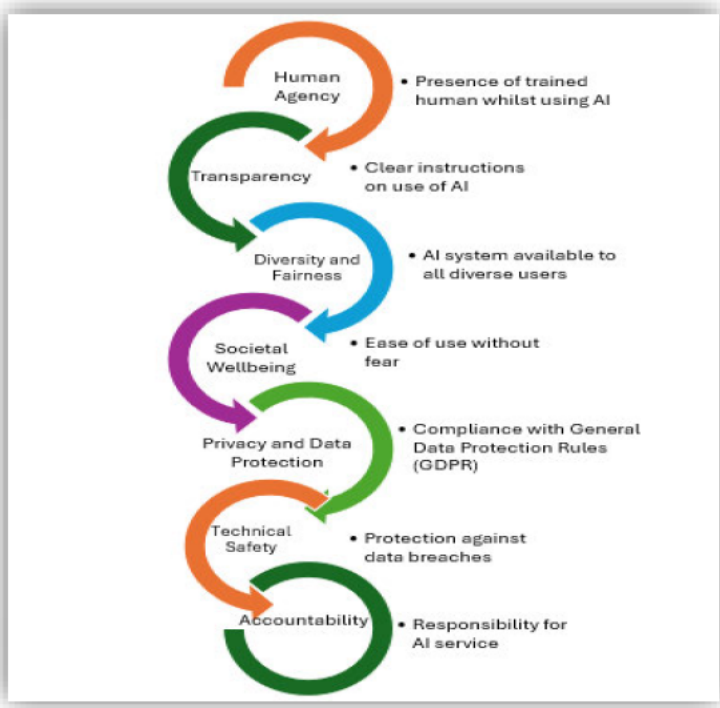

Figure 6: Diagram created from the Ethical Guideline Headings for human centred co-operation with Artificial Intelligence systems ((European Commission, 2022)

However, Williamson (2020, p.351) urges caution on the marketisation of education and states, ''datafication – the rendering of social and natural worlds in machine readable digital format – has most clearly manifested in the commercial domain' but it has also been recognised in the datafication of education and has the potential to exert significant effects on the lives of millions.' as it imposes limits 'on what is made visible and known' and 'establish what is claimed to be true or valuable, impose automation on decision-making, and affect the ways people feel, act and behave.' (Williamson, 2020, p.353).

2.3.6 Content - Language and Government

The stakeholders who influence and design the curriculum are not only educationalists but also come from government agencies, and in the case of apprenticeship, from industry and commerce. Duckworth, (2019, p. 41) comments on how the language of commercial formats has invaded curricula design to such an extent that 'incorporation encouraged principals to view themselves as Chief Executive Officers (CEOs)'. This trend in relating education to business is also noted in educational documents as demonstrated in the writing of Gert Biesta in, *What's the Point of Lifelong Learning if Lifelong Learning Has No Point? On the Democratic Deficit of Policies for Lifelong Learning*, (Biesta, 2006, p. 177). He raises the point that education for

learners seeking new skills or re-skilling, which is becoming more frequent in apprenticeship education, has been redefined in the *language* of policy documents from the Organisation for Economic Cooperation and Development (OECD) and the European Union (EU). New adult students to further educational institutions are now referred to as entrants to a 'learning economy' and the responsibility for learning has been placed on the learner. He further asks the questions, 'who has the (democratic) right to define the agenda?' and 'Is it the learner, the government, (global) industry?'. The question of *motivation* is also posed as he asks why learners should engage with education 'if they have no say in the content, purpose or direction of such learning?'. The 'learning for earning' imperative of the *learning economy* is not what education *ought to be about* as the learner is caught up in a struggle over the definition of learning, 'a struggle over what counts as 'real' or 'worthwhile' learning.' (ibid p.177). Biesta (2009, p. 5) in *Good Education in an Age of Measurement: On the Need to Reconnect with the Question of Purpose in Education,* continues his questioning on how the focus is on the *learner and learning* which he terms 'the learnification of education' and deems it an 'ugly term'. He posits that whilst there are 'emancipatory possibilities in the new language of learning' which 'can empower individuals to take control of their own educational agendas' there is also an inherent difference between learning and education. He warns that *learning* is an individualistic concept – engaged in alone even if 'couched in such notions as collaborative or cooperative learning' whilst *education* 'implies a relationship: someone educating someone else and the person educating thus having a certain sense of what the purpose of his or her activities is.' He also warns that learning is a process term and is as such empty or devoid of content and direction – it is open if not empty. In this new *language of learning* the questioning of content, purpose and direction of education becomes even more difficult with more hurdles and obstacles removing collaborative discussions and the important 'recognition that it also matters *what* pupils and students learn and what they learn it *for'*. (ibid, p. 6). He further states that to speak about 'education in terms of the acquisition of knowledge and skills is actually misleading, because skills .....never exist in a vacuum' as 'having skills or being skilful cannot occur without a subject' (Biesta, 2020c, p. 102) and the subject (person) is unique with their own sets of desires, needs, wants and abilities – and the qualities of mind and character - of what it is to be human. The question, he argues, which is the most important element of a discussion on a good education, is whether we are measuring what we value, or whether we are just measuring what we can easily measure and thus end up valuing what we (can) measure (ibid, p.10).

2.3.7 Assessment – What are we measuring?

One of the major problems with designing and developing a curriculum, apart from deciding which subjects should be taught or excluded, is to determine a means of assessment to gauge that the learning prescribed has been achieved by the learner. Assessments consisting of formative and summative assessments in programmes that can be norm referenced (subjective) or criterion referenced (objective) is a constant challenge in curricula design. According to Eisner (1993, p.228)

> 'The challenge to assessment is to somehow create tasks that give students opportunities to display their understanding of the vital and connected features of the ideas, concepts and images they have explored. In short, the aim is to help students demonstrate that they have grasped ideas as a part of a larger field and as historically situated elements within a community of discourse.'

The simplicity of these sentences does not fully relate the complexity and diversity of human responses to learning criteria as each person will develop their own methods of expression to relate, relive or remember the learning experience. Biesta (2009) argues for the return to the *purpose* of education and a movement away from the over indulgence in measurement tactics for evaluating humans and creating league tables on achievements in academia.

The coded language of reading, writing and maths can be problematic for some students. Maybe not all combined but whilst some people can speak and read they are unable to transfer their knowledge into words (code) on paper, others find it difficult to remember or apply the language of maths to different scenarios. They are not however, without intelligence but may have different methods of achieving their goals which may be linked to their bodily abilities as opposed to their coded use of 'languages'. They may have abilities in their hands which cannot be mirrored in coded writing or maths. They may have the imagination to create which cannot by captured in writing as Hannah Arendt says in her book, *The Life of the Mind* (1981, p.8), 'Nothing we see or hear or touch can be expressed in words that equal what has been given to the senses'.

With this philosophical view, how is it possible to assess what is aesthetically felt by all our senses when we view a craft, a process, a masterpiece? Barone and Eisner (2011, p.148) offer six general assessment criteria to evaluate work completed using the Arts Based Research methodology which can be assimilated and assigned to any work, project or problem based learning activity which includes the attainment of a skill or craft as follows (Table 3):

➢ Incisiveness – getting to the heart of a matter
➢ Concision – losing the unnecessary details.
➢ Coherence – aligning components of a topic into a natural fit.
➢ Generativity – opening the doors of a study/problem/project to view it from different perspectives
➢ Social significance – locate its significance and ask the questions that matter
➢ Evocation and illumination – to feel the meanings of the work, which is seen, read, heard and/or felt by all the senses.

Table 4: The general assessment criteria to evaluate work completed using the Arts Based Research methodology Barone and Eisner (2011, p.148

In a *cultural artistic* setting apprentices learning one craft, skill or trade can become part of communities where their talents, skills and creative abilities are entwined with those who possess other skills- where plumbers, carpenters, electricians, artists, IT specialists, singers, actors, scriptwriters and a myriad of other can unite. Interdisciplinary concepts involving projects that combine and meld one specific skill with another (as occurs in the real world) can be initiated in projects such as the design, building and creation of a film, a play or a concert – is it not then reasonable to include film studies, art and design or music into the curriculum programme of an apprenticeship? Coffield (2008, p. 43) describes his attendance, as a visitor, to a Vocational Education class for 18-19 year old apprentice electricians in Germany whilst he was researching the 'dual system' of apprenticeship. In one class the students were reading aloud a piece of German literature, Goethe's *Faust*. He asked a young apprentice later, what the significance of the literature study would have on his future career as an electrician and after a brief moment the student replied, 'electricians have souls too, you know'. Combining the Arts into apprenticeship curriculum and assessing its results can be achieved through many techniques one of which includes the use of modern technologies. Blending disciplines is not a new concept as proposed by Harden's Integration Ladder (2000, p. 555) where the first step is the teaching of a specific discipline in isolation based on its theory and practices, then moving upwards through, awareness, harmonisation, nesting, temporal co-ordination, sharing, correlation, complimentary, multi-disciplinary and finally inter-disciplinary. Apprenticeships begin with techniques and specifics but if initiated into other disciplines, along their educational journey, such as Arts and Humanities, there are no bounds to the imagination of the initiated

Modern technology has a place in modern assessments such as the use of Virtual Reality (VR) and Augmented Reality (AR) technologies which have the potential to create environments

virtually which cannot be established in *real time or space*, either due to costs, space and environment, health and safety requirements or lack of specialised equipment in a designated learning environment. Apprentices can now use these new technologies to *learn* how to use complex machinery, tools or materials safely and without danger in a virtual environment where mistakes can be made without actual real consequences and costs. Apprentices can now be assessed by video recording and presenting their narrative accounts of what they are doing *as* they are performing tasks and routines related to the acquisition and development of their skills and their craft. This includes their abilities in completing an assessment task, problem or project activity based involving hand eye co-ordination, hearing abilities, use of touch, taste, smell and all the senses. The apprentice can use an affixed body-camera or use a located camera to record their own bodily movements in completing the task in one session or over time. This method is not only an authentic and useful multimodal assessment technique but can also be used as a learning tool if viewed later as a reflection by the apprentice or if viewed in conversation and review with the teacher/mentor. Technology can help apprentices and those who assess their work to record the success of the task and also the mistakes being made, how they are remedied and the lessons learned. This method of recording and reviewing is often used in teacher/mentor training (Hidson, 2019) with the added benefit that perceived teaching 'gaps' can be corrected or modified following review.

2.3.8 Shifting Sands

Giroux (1988, p.6), 'calls attention to the shifting boundaries' related to mass media and new technologies', Rorty (2005, p. 371) believes that there is no absolute truth and what appears true in one generation has been proven to be false in others and requires a continuous 'conversation'. Oakeshott (1962, p. 198) describes the value of such a discourse as a 'conversation of mankind' where 'the participants are not engaged in an inquiry or debate' where 'there is no 'truth' to be discovered, no proposition to be proved, no conclusion sought. ....is not an enterprise designed to yield an extrinsic profit, a contest where a winner gets a prize, nor is it an exercise of exegesis; it is an unrehearsed intellectual adventure'. The rewards of which are that all voices are heard and, 'voices which speak in conversation do not compose a hierarchy' but instead have the propensity to show 'facts' as the possibilities which brought about their being, 'certainties' to be 'combustible' and 'approximations are revealed between notions normally remote from one another' (ibid, p.198).

However, in recognising that time changes perceptions and it is important to move with the times there are also some ideals that are worthy of remaining as a bedrock of human ambition, anchoring it to its main purpose which should always be actions for the betterment of the

individual and society. One such rooted ideal can be found in a memo written in 1920 by French Minister of Education Edouard Herriot, who stated that, 'By law, the worker is also a citizen and an individual. As such, he is not a means but an end; he must have the ability, not only to produce, but also to think; he is entitled to the culture which makes one an individual, that is to say, a free being.' (Méhout, 2011. P. 36). It is a very humane and generous description of a working person's right to a vocational education, one geared towards the creation of a better life for the individual whilst enabling them to participate and contribute to their own unique culture as free thinkers. Méhout outlines the contemporary French framework for vocational education as it is now contained in two sub-categories derived from the initial outline of *Savoir* – the French word for knowledge, which are *Savoir Faire (knowing how to do)* and *Savoir Étre (knowing how to be)*. The table below (Table 4) describes the differences between the two categories which unite in the pursuit of knowledgeable actions. However, Méhout (2011, p. 43) states that even within a system that acknowledges there are different ways of knowing exhibits, 'inherent tension between the twofold goal of qualifications, as educational or labour market currency'.

Savoir - Knowledge				
Sub - categories	Knowledge of:	Knowledge with:	Knowledge acquired:	Examples
Savoir Faire	Concrete situation – technical *Knowing how to do.*	Knowledge and experience	Learning and professional practice	Blue collar worker: Manual dexterity - dealing with breakdowns or malfunctions
Savoir Étre	Inter-personal relationships: Communication *Knowing how to be.*	Knowledge, experience, problem solving capacity, self-aware	Not innate but learned through educational process – Management skills	Working in a team(peers) or autonomously within a hierarchy.

Table 5:Description of the two sub-divisions of Savoir into Savoir Faire and Savoir Étre outlining examples of each. (Méhout, 2011, pp. 36-43)

The following diagram, (see Fig. 8), combines the *Conversation of Mankind* of Oakeshott with the *Savoirs* of Méhout as an outline for continued progress in the development of Apprenticeship curricula based on recognising the individual as a, 'free being'.

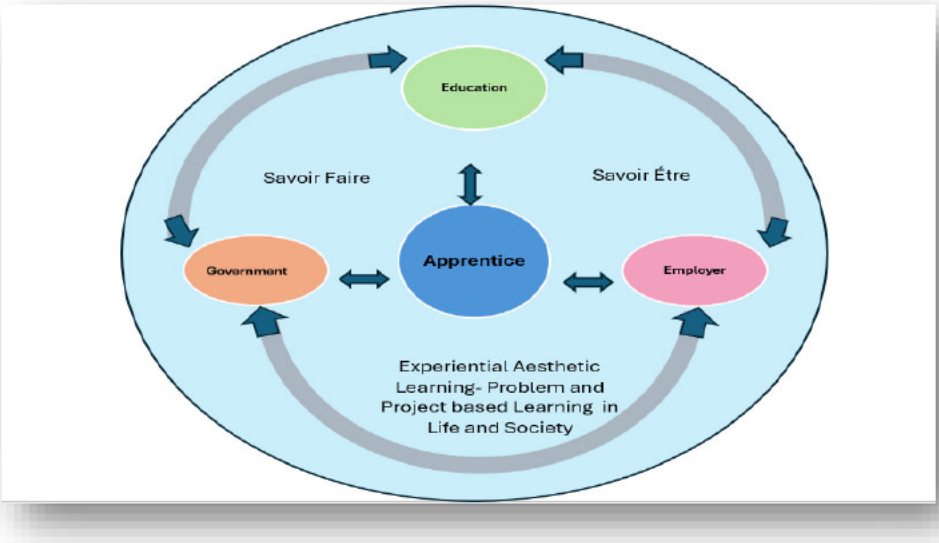

Figure 7: Diagram combining Oakeshott's Conversation of Mankind with Méhout's categories of Savoir (Walsh-Shanahan, 2024)

Integrated curriculum design requires a conversation – an ongoing everlasting conversation within a 'community of discourse' (Eisner, 1993, p. 228) - between all stakeholders who know that education involves immersion in all the colours of society and in all the flavours and textures of the materials used to progress humankind and create a sustainable earth. It involves all the human senses. This combination of Méhout and Oakeshott's theories are intertwined here in this diagram showing the stakeholders engaging in a conversation encircling Savoir Faire and Savoir Être – in efforts to produce a curriculum of experiential aesthetic learning.

2.4 Imagination

Perhaps the greatest source of human freedom is the ability to imagine. To imagine a different future, a future which requires action to change it from its present existence and to build on the experiences conceived in the past but which have not yet developed into a reality. Aristotle refers to imagination as *phantasia* describing it as, 'that in virtue of which an image occurs in us' (De Anima iii 3, in Shields, 2020), a concept different from perception and mind, but one which draws a pictorial imagery of human cognition as it produces, stores and recalls images which may not be true or based in reality such as those in dreams, thoughts and memories. However, once concepts or ideas are humanly imagined, it requires human action to change the imaginative thoughts into physical realities. Our human history has taught us that we have a gift for creativity and imagination. Rorty proposes that as the human race has advanced it has become wiser, as individuals become aware of more alternatives and the, 'source of these new alternatives is the human imagination' (Rorty, 2006, p. 372). These imaginative alternatives are not only present in the sciences but also in the enjoyment and pleasure of creative works of art

and literature, the creation of new art forms of video recordings and films, new designs of fashion and architecture, aesthetic performances by actors and singers, artistic creations of plays, poetry, art, music, songs, dance and many more human activities that have brought us pleasure and filled our senses – perhaps even our souls.

Maxine Green (1982) in her presidential address in Columbia University titled, '*Public Education and the Public Space*', raises the questions about the ability of education to do the job it was created to do. She notes how, 'Almost never is there an expressed concern about the public realm: there is silence about renewing the common world and about what that common world should be' (Green, 1982, p. 4). Greene proposes the idea that education should not merely be a means of, 'maintaining a society of quiet ones, of mere 'job-holders' and consumers' (Greene, 1982, p. 5). She construes the curriculum as a possibility – as a form of imagination where it was possible to, 'see imagination released and openings found in the arts, so that new languages can be explored and new perspectives opened, and so that young people will be enabled to look out beyond the actual and the given and summon into being alternative worlds" (Greene,1982, p. 9). Padraig Hogan, outlines several features of what it is to combine cultural diversity in teaching and learning by stating that human efforts to understand are, 'inescapably constrained by perspective', where we will always, 'understand incompletely' but 'to realise the best in ourselves as human learners is to become aware that we *are* the dialogue, whose possibilities can be taken up ever anew, or declined, or bypassed or even smothered' (Hogan, 2005, p.93).

Throughout the Commentary I attempt to graphically place Apprentices, Employers, Educational Institutions and Government into an encompassing Societal space where each is engaged in a 'Conversation' – similar to the one suggested by Oakeshott's *Conversation of Mankind* (1962). In using the term *conversation* Oakeshott outlines the characteristics of a conversation where, 'the participants are not engaged in an inquiry or debate' and where, 'facts' appear only to be resolved once more into the possibilities from which they were made' (1962, p. 198). He continues by stating the participants are engaged in a relationship which began, 'in the primeval forests' (ibid, p. 199) and which I believe should continue into our digital age and into our collective futures. In Appendix 7, I have devised a list of topics from each participant's perspective and aligned them to the other participants in a circular formation as each participant converses, learns, reflects and hopefully listens with a view to organising changes or 'alternatives' to their respective roles and participation in the conversation surrounding a successful programme of apprenticeship and vocational education. It involves all voices.

2.4.1 Ability and Learning to Learn

According to Sennett, (2009, p. 268), 'modern society sorts people along a strict gradient of ability' and 'the better you get at something the fewer of you there are'. This 'sorting' has advanced into academic and vocational education where there is a view that these two pathways should remain *separate* domains. On this I totally disagree. I believe knowledge, coming to know and ways of knowing, can be found in the actions and interactions of the hand and mind, in the ability to craft objects from metal, stone, clay and wood. I believe that apprenticeship is not only a vocational education but can and should include elements of academic arts and the full role of education is to allow the individual to experience through all of the body's senses that which can contribute to their knowledge of 'who they are' and 'what they can do' to survive and thrive in our society and contribute to the advances necessary for the continuation of our earth and its inhabitants. I have come to see education *as a voyage of discovery which involves the use of all the senses including imagination* and the exercise and development of wise judgment in practice. Eisner, in his John Dewey 2002 address at Stanford University, states that the influence of psychology on education had the effect of creating an estrangement between science and the arts where, 'science was considered dependable, the artistic process was not. Science was cognitive, the arts were emotional. Science was teachable, the arts required talent. Science was testable, the arts were matters of preference. Science was useful and the arts were ornamental' (Eisner, 2002, p. 3). Eisner argues, 'the highest accolade we can bestow upon someone is to say that he or she is 'an artist' whether as a carpenter or a surgeon, a cook or an engineer, a physicist or a teacher' based on their ability to develop ideas, have the imagination, skill and sensibilities, 'to create work that is well proportioned, skilfully executed and imaginative regardless of the domain in which the individual works.' (ibid, p. 5). The qualitative relationship for any particular work, irrespective of disciplinary field, is progressed by studies in the arts and crafts as students learn how, 'to act and to judge in the absence of rule, to rely on feel, to pay attention to nuance, to act and appraise the consequences of one's choices and to revise and then make other choices' to obtain 'a rightness of fit' (ibid, p. 6). Sennett portrays this view on qualitative judgement by presenting the two German meanings for the word *experience, Erlebnis,* meaning an event or relationship that makes an emotional impress) and *Erfahrung,* an event or relationship that turns outward and requires skill rather than sensitivity (Sennett, 2009, p. 288). Sennett believes that human beings need the constant, 'inner monitor of *Erlebnis*, of 'how it feels' to avoid the, 'vice of instrumentalism' and, 'be trapped by means -and- ends thinking and acting'. Both

writers give breath to the idea that when sensibilities are engaged the learning process is enhanced and the student becomes more, 'qualitatively intelligent' (Eisner, 2002, p.6).

Apprenticeship allows the student to engage with material consciousness as well as the opportunity to learn through all the senses that are engaged in the production of artefacts and in the attainment of skills using tools and also to learn how to form relationships and share qualities of mind and character in collaboration and co-operation. According to Sennett, 'the craft of making physical things provides insight into the techniques of experience that can shape our dealings with others' (Sennett, 2009, p. 289). In addition to learning how techniques shape our relationships with others, I believe that learning a specific skill contains the basic ingredients and techniques in learning another skill – which is the ability to learn *how to learn*.

Both Eisner and Sennett link 'ability' to the arena of 'play' in human cognitive development, as the child's ability to 'differentiate and form concepts and to represent these concepts reflects the use and growth of mind' where 'intelligence, in a sense, has to do with the competence or skill with which we conduct some activity' (Eisner, 2002, p.24, Sennett, 2009, p.269). Learning how to learn, how to question, how to disagree, how to challenge the norm, how to create, to invent new alternatives, to bring about a new world of sustainability and growth, to protect our young and our planet and how to be brave enough to go against the tide is a worthy challenge to those in education and by extension to all of us in modern society today.

This leads to the questions; would apprenticeship learning be enhanced by studies outside the specific range of topics now offered in relation to their own distinct fields of learning? I believe they would and I agree with Pring, (2005, p.204) who describes education as, 'a vehicle to allow young people to explore (in the light of evidence and argument) what it is to be human' and that, 'such an exploration has no end'. The explorative journey which combines the theoretical and bodily acquisition of skills, qualities of mind and knowledge in apprenticeship – possibly the oldest known form of education – the art of passing a learned skill on to the next generation – may be regenerated in an invitation to the Conversation of Mankind, where old meets new in recognition of the need to re-imagine the role and importance of the senses in education. I propose this can be achieved by including aspects from the arts, humanities and sciences into vocational and apprenticeship learning with the addition of subjects such as communication studies, computer literacy, film and drama studies, art appreciation and design, culinary arts and many more (see Fig. 8).

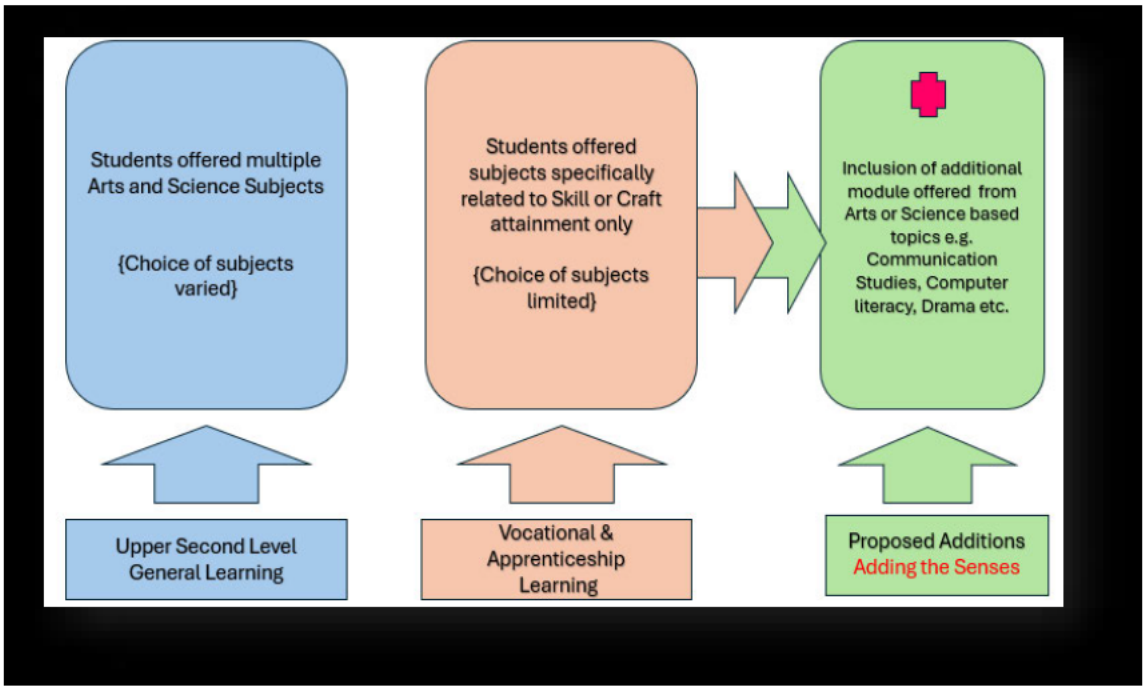

Figure 8: Diagram showing Upper Second Level and Vocational/Apprenticeship learning subject choices with proposed additional choices for the latter.

2. 5 Current Reports and Findings on Apprenticeship Systems

Erica Smith (2023, p. 20) the academic and prolific author on apprenticeship systems, in collaboration with many stakeholders in industry and government through funded projects, outlines some of the main problems with attracting entrants into apprenticeship are (see table below):

Main problems associated with attracting new entrants to Apprenticeship programmes	
1	The low status of apprenticeship – including the low status of vocational education and training (VET) itself
2	The higher status of academic pathways in schools and post school routes to universities and technological institutions.
3	The increase in accessibility to higher education (HE) has increased greatly since the middle of the 20th century (Marginson, 2016).
4	The non-promotion of apprenticeship systems and the level of influence by career advisors, using Bronfenbrenner's ecological systems theory (ILO, 2022, p.15) were identified as: Micro-system: Family members Meso-system: Community, school, careers advisors, associations Macro-system: Society, Media, Public Information
5	The apprenticeship system is associated with manual labour and classified as working class – a lower rung on the social status ladder.
6	The practical considerations of low pay and unsociable hours of work along with working conditions

Figure 9: Main problems associated with attracting new entrants to Apprenticeship programmes

The International Labour Organization (ILO) in their report social perceptions of apprenticeship noted that other more financially rewarding employment opportunities are available 'as the remuneration associated with apprenticeship is usually quite low' initially (ILO, 2022, p.13)

Other notable contributors to the field of apprenticeship include Simon and Clarke (2016) who conducted research on the low participation rates of women and girls in male-dominated careers in construction and engineering through vocational educational routes. They concluded that a greater focus is required in providing a 'wider range of opportunities to "taste" a variety of careers' (ibid,2016) which should be introduced at school level and proposed a collaboration with industry and community. Pagnaccolo and Bertone (2021) state that the nature of skills developed in education has led 'some employers to claim that young people are not 'work ready' and more choices for future employment opportunities would arise through the development of 'Transferable generic skills such as teamwork, problem-solving and communication'.

James, Garner and Husband's (2021) final words, in their research paper on governance disparities in Further Education Colleges in the UK, is 'to take 'cultural' elements as seriously as 'structural' elements' when refining guidance. These words of wisdom can also be attributed to the creation of novel curricula developments in vocational education and apprenticeships where the introduction of a variety of Arts based and cultural modules could be introduced into specific course content.

This Commentary acknowledges that apprenticeship and vocational education face global challenges, which are further complicated by diverse, context-specific issues that vary not only between countries but also between regions and communities within a single nation. These challenges are reflected in the six key reasons outlined above, highlighting the need to harness the potential of skilled apprentices, retain them in the workforce, and equip them with the knowledge and confidence to pursue lifelong learning in an ever-changing world. Targeted funding for vocational education and financial incentives for businesses to hire apprentices are *key strategies* to boost vocational uptake, retain skilled workers, and support career changes or reskilling.

However, the main focus of this Commentary is to answer the research question on how to restore imagination and the senses to apprenticeship and vocational education. It requires imagination and dedication from all invested participants. The model for Apprenticeship and Vocational Education stands here as a foundation for shaping curriculum development and design and mentorship programmes.

Chapter 3 – Methodology

3.1 Ontological and Epistemological Position

I would like to confirm my interpretation of knowledge as a belief that there are different forms of knowledge; that human beings develop knowledge through all of our senses, that experience is multisensory and not limited to cognitive functions. I believe that knowledge is based on experience, that mind and body, theory and practice are not separate but deeply connected. Coe et al. (2017, pp16-18) state that there are four questions which determine the basis of understanding the personal assumptions formed by researchers (including myself) in the adoption and use of specific techniques in data collection. The first queries the researcher's Ontological perspective; *What is the nature or form of the social world?* My view can be seen through my professional experience as well as the research presented here. In creating the Model of Apprenticeship and Vocational Education, I drew on over 30 years of personal experience in teaching and learning across second- and third-level education. It is my understanding that lifelong learning, shaped by this journey, recognizes that education happens beyond the classroom—through varied techniques, methodologies and technologies.

My career background in business coupled with an academic teaching and research background, (first-class honours degree in Information Communications Technology from Dublin City University and a first-class master's degree in education from the South East Technological University, Ireland) inform my philosophy that education should endeavour to unlock human creativity by exposing students to diverse topics and holistic learning experiences that inspire lifelong learning and curiosity. Vocational education, therefore, should move beyond skill training for employment alone. It should integrate blended learning, emerging technologies, interdisciplinary projects, and multi-sensory experiences rooted equally in science and the arts. The goal is to foster learners who are not just skilled but also imaginative, critical, and capable of sustainable, human-centred innovation. I believe the form and nature of the social world is neither singular nor objective and each person can construct multiple realities based on their own experiences of living in the world. The second question is based on assumptions about Epistemology: *How can what we assume to exist in the social world be known?* Influenced by a constructivist ontology my epistemological standpoint is interpretivist where how a constructed social world can be known is not based on direct knowledge of social phenomena but on the interpretation of observations and accounts of the world provided by indirect indications and interpretations of accounts of experience provided by others as well as my own. The third question is based on Methodology: *What procedures or logic should be*

followed? And the fourth question is based on Method: *What techniques of data collection should be used?* These last two questions are answered now in an analysis of my personal research methodologies and synthesis of data collected.

3.2 Research Methodology

The research methodologies presented across my Commentary and published works (Publications 1–10) incorporate both configurative and aggregative synthesis logic, as outlined by Zawacki-Richter et al. (2020), and are shown here as follows:

Type of Logic	Examples of personal use of logic
Configurative synthesis logic	*This logic employs exploratory and iterative methods to report on processes that are functional, productive and valuable to both the discipline and the broader community* which is demonstrated in the selected publications offered here. The papers use primary research methods – such as observation, design of action projects and a development of challenge or problem-based learning – to examine a range of outcomes applicable in educational settings. These outcomes, whether interdisciplinary or cross-national, have the potential to deliver meaningful societal benefits when further developed.
Aggregative synthesis logic	*This logic supports investigative theory by testing, exploring and refining ideas, while minimising bias and emphasising consistency across studies. It typically results in a statistical meta-analysis or a comprehensive overview of the research question.* This approach is evident across all of the publications presented here and is focused on developing new models of education or expanding new concepts from multiple combined factors, creating practices and concepts for further development.

Figure 10: Examples of Personal Use of Logic Types

Both types of synthesis logic can be viewed as a mixed method approach lending depth and breadth to the topics under study often as follow-ups or extensions of previous studies. For instance, Publication 2 in this Commentary, *The development of a novel educational model to successfully upskill technical workers for Industry 5.0: Ireland a case study*, is a response to an earlier research project in a large pharmaceutical company, using primary research methods of interviews and focus group discussions, where on-site training in new technologies proved challenging (Costello et al., 2019). Doyle-Kent and Walsh Shanahan (2022) in the follow on paper propose a new programme based in a nearby third-level institution, combining practical classroom sessions with online and blended learning techniques to meet staff needs e.g. shift work and varying degrees of competency with new technologies etc. The programme is currently under development in collaboration with the college, the company and employee representatives, as funding is being sought nationally and internationally.

The Systematic Review process in all my work follows the model outlined by Newman and Gough (2020) on methodologies, perspectives and application of research in the educational context. My research process is outlined in the table below

Research Review Process		
1	Developing the Research Question.	My question is: *How to restore imagination and the senses to Apprenticeship and Vocational Education?* There were many sub-questions within this simplistic question but it was a place to begin and to study the key issues and the constructs which would synthesise into the model for Apprenticeship and Vocational Education.
2	Designing a Conceptual Framework	My conceptual framework contained many implicit and explicit research questions and I categorised them into the following epistemological groups e.g. *Knowledge:* who are the philosophers on knowledge? what part does philosophy play in educational *Practice*? Who are the philosophers and educational theorists and other stakeholders involved in *Curriculum Design and Development*? What is the significance of restoring *Imagination i*nto education and a return to including all the senses to a lifetime of learning? What are the Current developments in Apprenticeship? These were the five pillars of my conceptual design – the other areas would be concerned with introducing my work as a holistic concept – a novel educational model - showing my passion for education, my methodologies and in conclusion discussing my view of how vocational education could be improved, enhanced and become more 'human-centered' in line with the concepts held in Industry 5.0 – but much more to allow all of us learners to remain human and employ all our senses with imagination for a better world.
3 & 4	Selecting Criteria and developing the research strategy	The selection criteria used by me in gathering relevant information from databases in libraries, both online and physically, is always dependent on ensuring the data follows the certain criteria (acknowledging the differences that educational research can contain in different countries and with different parameters) which are: English language, peer reviewed, published in conferences, journals, and are included in databases or libraries with recognisable editorial and ethical guidelines. Included here is the process illustrating the initial University library database search for my Literature Review chapter, under the section *Current Developments in 'Apprenticeship'*. The search began with a total population of N = 448,627 (keyword: Apprenticeship), which was narrowed to N = 180,212 (peer-reviewed), then further to N = 78,828 (published within the last 10 years), and finally to N = 17 (specific to Vocational Education). See Diagram of Search Process.
5 & 6	Selecting relevant studies and appraising their quality	From this refined selection, I downloaded the *full publications*, read them fully, judged the quality and appropriateness of the study with relevance to my own research. I also viewed each publications Reference List a) to identify key authors and organisations in the field and b) to select authors with multiple publications demonstrating a broad understanding of my research focus on Apprenticeship—the results included Professor Erica Smith, Stephen Billet and Linda Simon amongst others.

Table 6: Research Review Process

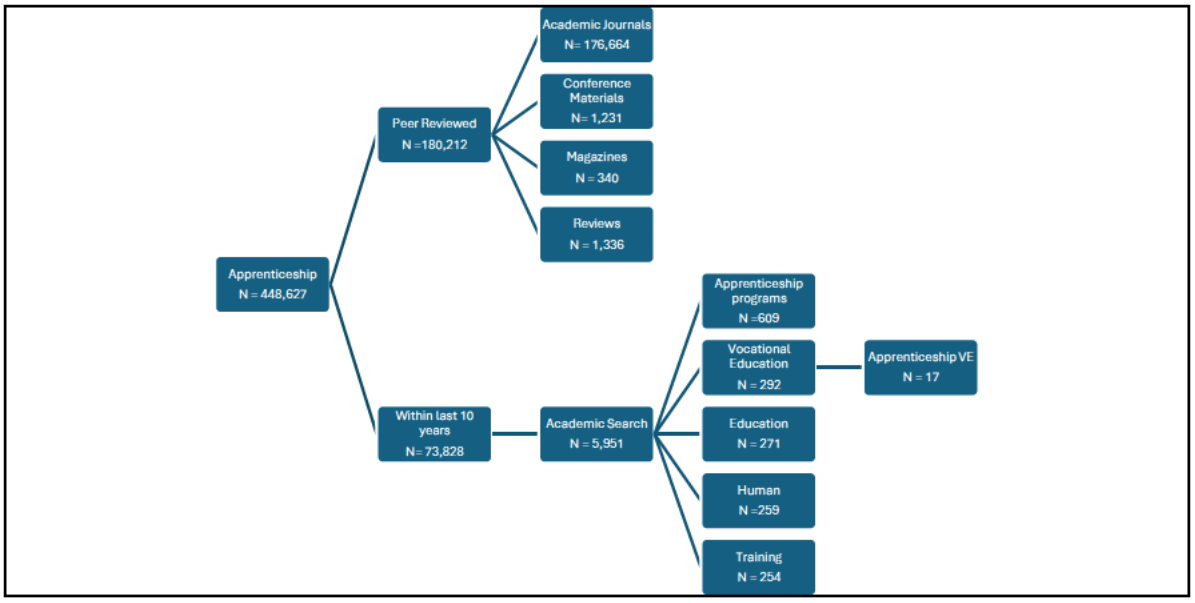

Figure 11: Diagram outlining the University Library Search Criteria for word "Apprenticeship"

3.3 Synthesis of Research

To manage and synthesise the volume of publications, I created a spreadsheet listing each source (author) and used a colour-coded system to identify key study areas and themes relevant to the specific question under review. I have included a snapshot of my synthesis of 13 publications by Prof. Erica Smith and co-authors (see Appendix 8) showing key points extracted from each publication which were further analysed by using colour highlights (as a code) to locate studies involving specific items under scrutiny e.g. 'primary action research' where the colour 'yellow' was used. This helped to locate the publication of a large international primary research study selected for use in my Commentary's introductory chapter in support of my study on the importance of apprenticeship on the global stage and the significant role of apprenticeship in vocational education. This method, used in all my research, helps me locate, categorise, and evaluate content through configurative analysis in the development and verification of my own concepts informed by evidence from other research material.

It is a Critical Interpretive Synthesis (CIS) considering my own voice as author in the research and 'prioritises relevance and theoretical contribution over research methods' (Newman & Gough, 2020, p.18). In synthesising my published works with the literature review in this Commentary on selected philosophers and their theories, I developed the following table to illustrate the connections between these theories (and theorists) across the categories of Knowledge Formation, Curriculum Design and Pedagogy, Multi-sensory Assessment, and Aesthetic and Experiential dimensions (see Table 6).

Papers and Chapters	Formation of Knowledge	Curriculum Design/Pedagogy	Multi-sensory + assessment	Aesthetic /Experiential
Philosophers/Theorists	Aristotle Sennett Merleau-Ponty	Dewey Bernstein BFI Lave & Wenger	Eisner Greene Hyland	Dewey Eisner Sennett Merleau-Ponty
The Global Apprentice: Adaptive, Versatile and a Lifelong Learner.	✓	✓	✓	✓
The Development of a novel educational model to successful upskill technical workers for Industry 5.0: Ireland a case study.	✓	✓	✓	✓
Interdisciplinary Approaches in Engineering Education: Preparing Young Minds for Complex Challenges.	✓	✓	✓	✓
Mentorship in Engineering: Women, Inclusivity and Diversity – A challenge for our times	✓	✓	✓	✓
Harnessing the Benefits of Micro Credentials for Industry 4.0 and 5.0: Skills Training and Lifelong Learning	✓	✓	✓	✓

Table 7: Table presenting a synthesis of theoretical concepts from the theorists presented in the Literature Review chapter and the publications presented in the Introductory chapter (Publications 1-5))

3.4 The creation of the Model for Apprenticeship and Vocational Education

In creating the new model for Apprenticeship and Vocational Education (as seen in Figure 3), I have systematically aligned my working knowledge, based on my experience, and combined it with the concepts of Méhout's Savoir Faire (knowledge to do) and Savoir Être (knowledge to be). The model presented here is an adaptation of the British Film Institute's (2015) educational framework which is different in all aspects but similar in the last two rows where human growth through the use of sensory skills is a shared concept between my life's work and that of the institute. This view of human centred personal growth and societal participation is further shared with the advent of the European Commission's Industry 5.0 initiative on production and manufacturing processes – emphasising human-centred expertise and social well-being. It is a recognition of *human skills as opposed to the digitisation prevalence of previous initiatives* as the worker is now to be valued and encouraged to engage in lifelong learning to aid economic growth (European Commission, 2025).

The model's section under *Savoir Faire* (knowledge to do) features six dynamic columns outlining the necessary skill development stages which are not linear or confined to levels but

must still allow recognition of prior learning for health and safety reasons in their application and delivery especially where knowledge and experience of tools, machinery or chemicals are involved. These columns guide learners through stages of theoretical and practical knowledge, culminating in advanced engagement with creative disciplines and student-driven outputs—such as portfolios, journals, video productions, podcasts or written studies of tools and trades from historical or narrative backgrounds, creative use of new technologies —demonstrating mastery and innovation within their vocational field.

Under the *Savoir Être* section, the model emphasizes the development of human values and dispositions—such as care, pride, curiosity, and empathy—essential to vocational education. These qualities foster not only a deeper appreciation for one's craft but also encourage lifelong learning and imaginative creative and societal ingenuity and engagement. The model is grounded in insights from educational philosophers and theorists, industry needs, and the evolving role of vocational education in curriculum design. The final row of the model is the proposed formation of a link between life and work through the creation of responsible workers, global citizens and a better life.

3.5 Ethical Considerations

The research conducted for the publications and Commentary have followed the ethical guidelines of an academic study. Participants were informed of all studies and the option to withdraw was always present for projects recorded in publications. The data confidentiality and anonymity of the participants remain confidential and the integrity of the research was produced with honesty and objectivity without fabrication or manipulation.

Chapter 4 – Discussion

4. Introduction

In the previous chapter I presented a synthesis (see Table 6) of the ties between my published work and the theorists and main concepts of a) Formation of knowledge, b) Curriculum Design and Pedagogy, c) Multi-sensory pedagogy and d) aesthetic and experiential. In this chapter I will discuss the ties and synthesis between my Commentary, the teaching methodologies in my published works and my model of apprenticeship and vocational education under the headings a) How it might be utilised and tested, b) Who might avail of its properties and c) the impacts on practice from the model. All of the theories in my literature review and the four pillars which form my synthesis, categorised above (a-d) inform my work and is evidenced through the multi-sensory and aesthetic experiential nature of the model's sections detailed below.

4.1 How the model can by utilised in Educational Institutions

Key Dimensions of apprenticeship, vocational Learning	Practical Reasoning/Workplace Learning Processes/Practices/Participation	
Areas of Learning Knowing how to 'DO' Savoir Faire	Specificities of the practice of the craft/skill/trade Planning and preparation for practice; organisation and execution of practice; implementation of new projects, repair or renovation; equipment maintenance. Engage with the real world of work as an apprentice learner	Social personal and collaborative and cooperative practices Planning and preparation for practice; organisation and execution of practice; implementation of new projects, repair or renovation; equipment maintenance. Discover new opportunities for partnerships or collaborative work
Qualities of Mind and Character Knowing how to 'BE' Savoir Être	Critical thinkers Confident explorers	Adventurous creators Informed Participants

Figure 12: Section of Model - Practical Reasoning and Workplace Learning

The first two columns of the model, under *Savoir Faire*, contain essential specific learning criteria of the trade, craft or skill under study in the workplace or in the educational institution. It involves learning theory and attaining a knowledge of the tools used in the completion of the skill. In the second column the creation of *teamwork* is introduced where the skill is seen to be of a shared value and can be created in collaboration with other team members. Project based learning techniques can be utilised here requiring the individual to join a team, communicate

within the team, work on and complete a project or process and report its findings. The reporting of the findings could be presented to others for assessment by a number of means, by writing a report detailing the sequential stages of the teamwork, by PowerPoint presentation and/or Excel spreadsheet software, by video recordings of the process, by interviews recorded via a podcast or individual learning journals collected into a reflective journal of each participants part in the process. These are just a few of the ideas which could be used to introduce the 'soft skills' of communication, team work, use of technologies, critical thinking and problem solving skills now required in the workplace. Under Savoir Étre the required employment and social aspects of critical thinkers, confident explorers, adventurous creators and informed participants have been developed in line with their new practical learning.

Problem Finding, Problem Solving and Critique Problem and Project Based Learning and Multimodal Assessment	
Critical personal engagement with practice under study Planning and preparation for practice; organisation and execution of practice; implementation of new projects, repair or renovation; equipment maintenance. Engagement with the practice in all its forms.	Wider engagement with Humanities subjects (outside main subject) Engagement with the history, culture and traditions of the practice – stories and images of practice. Discover historic relationships of new and old apprenticeships or skill training – a view from the past. Using viewing and evaluating of artefacts and connoisseurship as a way into making and taking pride in a job done well. Experience the narratives and real world practical examples offered by mentors in workplace and other settings in vocational education. Discover new methods of craftsmanship from external sources. countries, cultures, disciplines
Expressive communicators Effective listeners and collaborators	Sensitive contributors Enthusiastic advocates

Figure 13: Section of Model - Problem Finding, Problem Solving and Critique

The third and fourth columns of the model expand on the new learning recognising a growth in the learning process and introducing a feeling of belonging to a trade or craft by introducing the past histories of the skill under study. This can be achieved by watching videos of old methods of craftsmanship, inviting guest speakers into classrooms or arranging visits to external workplaces to view the craft, trade or skill being performed.

Aligning traditional and modern methods and tools of production with the learner's world can be achieved by allowing them to engage with both, utilise all their senses to feel the differences. They can critically assess how new technologies have advanced older techniques through innovation and creativity and explore how production methods vary across countries. For example, a documentary on the reconstruction of Notre Dame Cathedral, following the 2019 devastating fire, shows how artisans had to relearn old, and sometimes forgotten, techniques in stone masonry, carpentry, plumbing, and architecture to replicate the original structure. The viewing of the documentary could be followed by a discussion on the labour-intensive nature of older tools and how human creativity drove advancements and still continues to do so with imagination. Under Savoir Être the qualities of expressive communicators, effective listeners and collaborators, sensitive contributors and enthusiastic advocates are presented and potentially developed within the learner. The passion of others can be infective and influential in creating a love and pride in the skill under study.

Figure 14: Section of Model - Qualities of Mind and Character

The final two columns of the model involve a recognition of arriving at a complete or near complete mastering of the skill under study leading to the feeling of expertise and confidence in the learner's own abilities. It is at this phase the learner can explore new methods of 'doing' as past failures and errors will have informed the expertise with a knowledge of what *not to do* and

how it can be *done better.* At this stage the learner is introduced to problem solving abilities perhaps by introducing a problem which could be a social problem from outside the classroom or workplace e.g. a charitable requirement, a need for the skill /trade/craft which is not easily or affordably available in the community or in a wider social context to be evaluated and results drawn from active participation in solving the problem. It would also introduce cross-disciplinary engagement with other skills/trades/crafts working together to solve the problem or create possible solutions to alleviate it. Participation in the project or arriving at a solution would be an *elective* module, similar to a micro-credential, which could be included in the learner's overall transcript of achievement and qualification, or as an extra credit, if all mandatory requirements of the programme of study are fulfilled. The Savoir Étre of this final phase is the development of active collaborators, engaged citizens, reflective practitioners and independent and autonomous learners.

The last two rows of the model outline the dispositions for learning fostered by adaptation of the model through the creation of humans who have a spirit of enquiry, a tolerance and understanding of all human and technological diversities and change but mostly possess an appreciation and pride in their skill and a love and willingness to engage with lifelong learning for their own betterment and for that of their earth and society itself.

The processes above are not linear and can occur at many stages throughout the apprentice's or vocational learner's journey. It does require imagination on the part of the teacher, available funding for trips and a willingness on the part of all concerned to engage with new teaching practices leading to a fuller education involving all the senses.

4.2 How the model can be utilised in the Workplace

The workplace model can follow many similar steps to those in the classroom by incorporating mentoring and hands-on learning with skilled masters, sharing their stories of 'how things were done in the past' and insights on how skills have evolved. Modern techniques, such as robots and computer-controlled systems, have replaced manual labor, sometimes enhancing human work, other times reducing workers to mere overseers. This model bridges the gap between the workplace and educational institutions, where both contribute to knowledge sharing and problem-solving. As learners grow in competence, workplaces can engage them in developing new methods, fostering collaboration, and experimenting with innovative ideas, all while adhering to safety protocols. This collaborative, creative process plays a vital role in shaping skilled employees with a future in the company, within their chosen apprenticeship field, or extended into lifelong learning of new skills.

An example of this is the tradition at a crystal manufacturing plant, where upon completing an apprenticeship as a designer, the apprentice is given the opportunity to create a new design and see it brought to life—blown, cut, and polished—into a personal 'masterpiece'. This act symbolizes the culmination of their apprenticeship, offering a sense of self-achievement and pride in the creation of a new artefact, crafted with the combined skills of the apprentice and their colleagues.

4.3 How the model could be tested as a Policy informant

The aspirational application of the model lies in policy development, where the focus is on human-centred creation and development and is prioritized at every stage of the process to foster a more inclusive, equitable, and diverse society. This involves key stakeholders: employers providing input on required skills for production and progress, employees (via unions or advocacy groups) ensuring the protection of work-life balance, educational institutions guided by their Governing Boards and faculty, and government agencies overseeing apprenticeships and vocational education, aligning programmes and securing funding for further education and apprenticeships.

It is hoped to utilise the model in future trials with teaching colleagues as they design new programmes, apply for funding for new programmes and portray the model as a step in the development of a human-centred vocational education. The model showcases a connection to real societal issues, fostering interdisciplinary collaboration across the arts and sciences while promoting a caring, human-centred approach to education. It emphasizes learning for its own sake, not just for economic gain, with the hope of attracting both young and mature learners to vocational education that evolves with society's needs. In an era of rapid advancements in Artificial Intelligence, it is crucial to preserve human skills, creativity, empathy, and, above all, our responsibility to care for the planet, ensuring a sustainable future for our children.

Chapter 5 – Conclusion

It is a personal perspective that educating our next generation should not be borne of educating an individual with skills designed specifically for the world of work but that education should foster within an individual a love of learning which will generate critical thinking and creativity in collaborative and co-operative environments from educational settings to those of the workplace and society.

History has taught us that the human spirit, if collectively gathered with one purpose, is capable of extraordinary acts of courage and creativity. Education offers a way forward to change, to imagine and to act. This will involve cumulative human actions to create and design new means of production of goods, food and medicines, to embrace new technologies with ethical and human centred involvement, to converse with all partners in our respective societies and above all to improve our quality of life and work with diversity and inclusivity for all of us who work for a living. It is a huge task – and it must begin with education. An education that is inclusive and diverse, with the full complement of subjects, engaging *all* the senses and introducing students to the arts and the sciences in apprenticeship and vocational learning.

The Model for Apprenticeship and Vocational Education introduced here is an invitation to begin the conversation on our collective futures – ones not yet written - but alive in our imaginations awaiting the moment when the collectives combine to form an educational system *where all the human senses* are equally valued and utilised in our endless human pursuit of knowledge and the betterment of our world.

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APPENDICES

Appendix 1: Table showing details of the reviewed Five International studies on Apprenticeships from 2012 to 2018

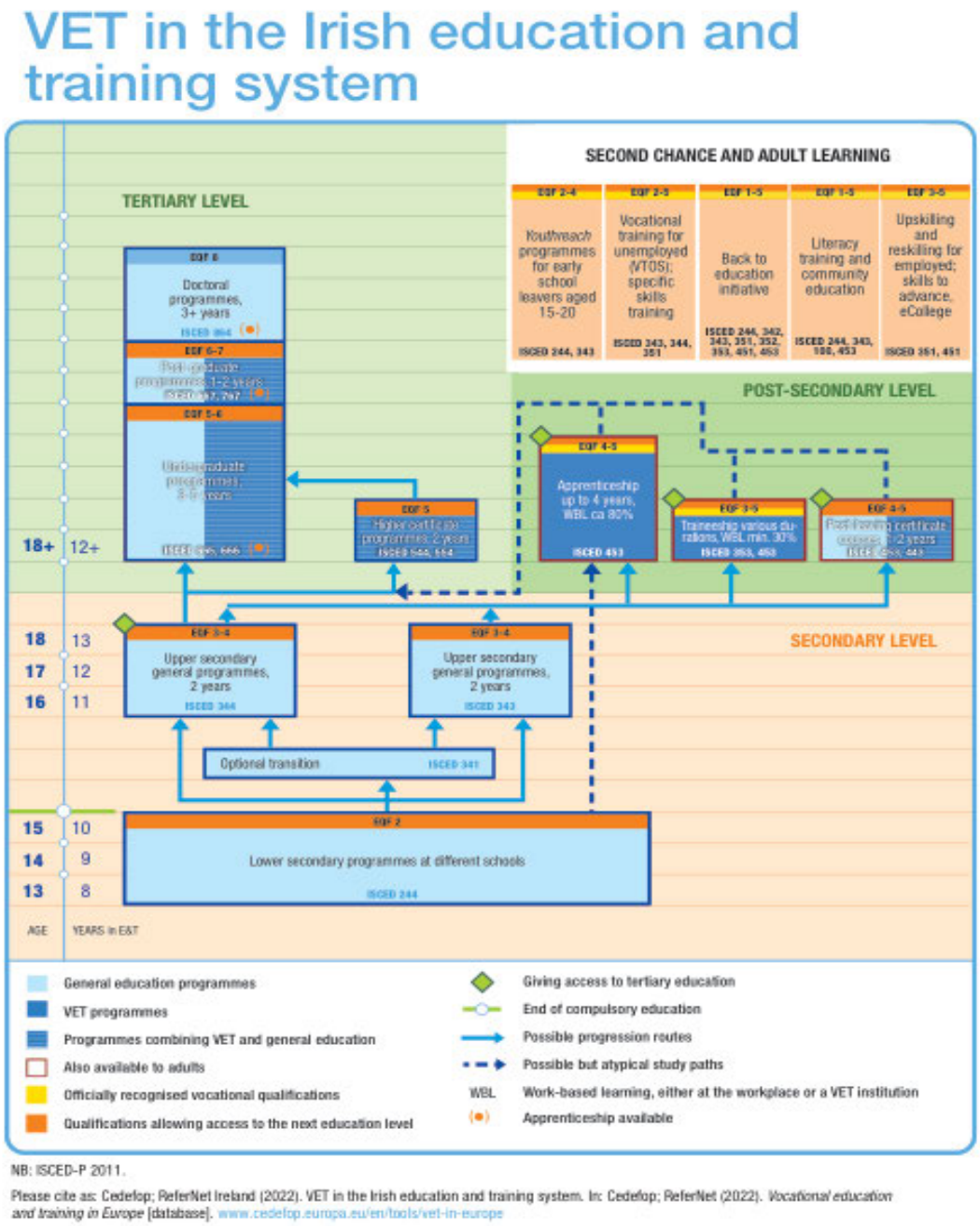
TABLE 1 Five international comparative studies of apprenticeships 2012–2018

Study no.	Author(s), title	Countries examined	Method of study	Year of publication
1.	European Commission, *Apprenticeship supply in the member states of the European Union.*	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, France, Finland, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, UK (27)	Production of 'country sheets' for all 27 countries based on statistical data, government web sites and reports. Nine detailed country case studies including interviews with stakeholders and experts (pp. 138–139).	2012
2.	Smith, E., and Brennan Kemmis, R., *Towards a model apprenticeship framework: A comparative analysis of national apprenticeship systems.*	Australia, Canada, Egypt, England, France, Germany, India, Indonesia, South Africa, Turkey, US (11)	Production of highly structured country case studies by national experts, each including an interview with a government official. Each peer-reviewed by a country expert. Thematic cross-country analysis (pp. 11–12).	2014
3.	Fazio, M. V., Fernández-Coto, R., and Ripani, L., *Apprenticeships for the XXI Century: A model for Latin America and the Caribbean?*	Established systems: Australia, Austria, Canada, Germany, UK, US (6) Less established systems: Turkey, Lithuania, Malta, India, France (5) Latin American countries; Brazil, Chile, Colombia, Costa Rica, Mexico, Peru (6)	Templates reporting on the apprenticeship system countries, from multiple sources, using elements derived from analysis of 15 international reviews. Cross-country analysis (p. v).	2016
4.	Chankseliani, M., Keep, E. and Wilde, S., *People and policy: A comparative study of apprenticeship across eight national contexts.*	Australia, Denmark, Egypt, Finland, Germany, India, South Africa, UK (8)	'Country notes' based on government material, reports by international organizations, statistical data from World Bank and UNESCO, and peer-reviewed articles. Thematic cross-country analysis (pp. 18–19).	2017
5.	Smith, E., Tuck, J. and Chatani, K., *ILO survey report on the national initiatives to promote quality apprenticeships in G20 countries.*	Argentina, Australia, Canada, China, Germany, France, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korean, Turkey, UK, US (18)	Analysis of responses to a survey, based on the 2016 G20 Initiative to Promote Quality 'Apprenticeship', administered by the ILO to the social partners (government, trade union and employer representatives) in G20 countries (pp. 4–5).	2018

	Author Date	Inherent features	Strategies for Attractiveness
1	European commission (2012)	Facilitating a rapid school to work transition A combination of theoretical and practical skills Are in areas of employment demand, since otherwise employers would not offer places	Avoiding dead-end programs – pathways to further study Providing skills development beyond those needed in particular companies
2	Smith, E and Brennan Kemmis, R. (2014)	Prescribed length of relationship with employer; the term is medium length Apprenticeship available in a range of occupations National qualification or apprenticeship curriculum Apprenticeships available in all geographic areas	Offering apprenticeships in attractive occupations Offering apprenticeships in occupations which attract women as well as men Creating a culture of training in more industries Opening systems to adults and young people alike Offering an employment contract Offering a wage level to encourage individual engagement while not discouraging employers Providing access for disadvantaged people
3	Fazio et al., (2016)	Providing hands-on experience	Providing a salary Providing a qualification Providing access to career ladders If not paid: Provision of learning materials, tutorial costs, food and transport Giving extra support for vulnerable groups
4	Chankseliani, M., Keep, E and Wilde, S. (2017	The appeal of learning through doing Occupational and/or workplace socialisation Offering the possibility of progression to (permanent) employment or additional education	Learning while earning Leading to long-term employment
5	Smith, E., Tuck, J and Chatani, K. (2018)	Process for safeguarding apprentice working conditions Provision of apprenticeships across the economy Provision of a credential or qualification	Processes for safeguarding apprentice working conditions Provision of apprenticeships across the economy Aiming at national goals for apprentice numbers Expanding occupational coverage Providing pre-apprenticeships and higher level apprenticeships Marketing campaigns via a range of media at the general public, careers, advisers/schools, individuals Extra support of disadvantaged people, minority groups and women to commence and complete apprenticeships and campaigns to attract them Good working and training conditions

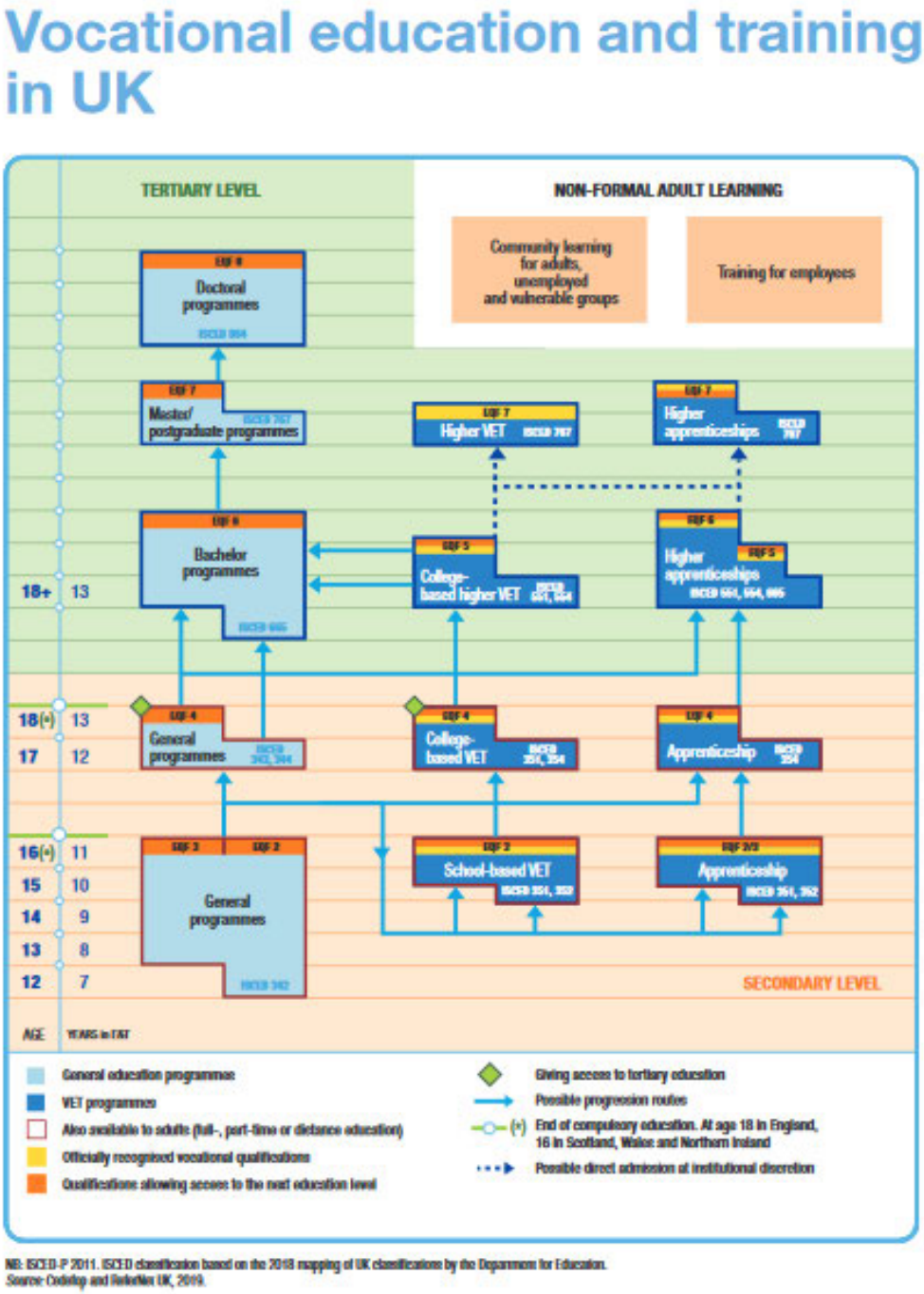
Appendix 2: Table showing the most attractive strategies for attracting people into Apprenticeships drawn from the studies of 2012-2018

Appendix 3: Diagram showing the outline of the Irish Educational Vocational Training system



Full Description of the framework may be found at: Cedefop; Vocational Education and Training Ireland System Description. Available at: https://www.cedefop.europa.eu/en/print/pdf/node/147516

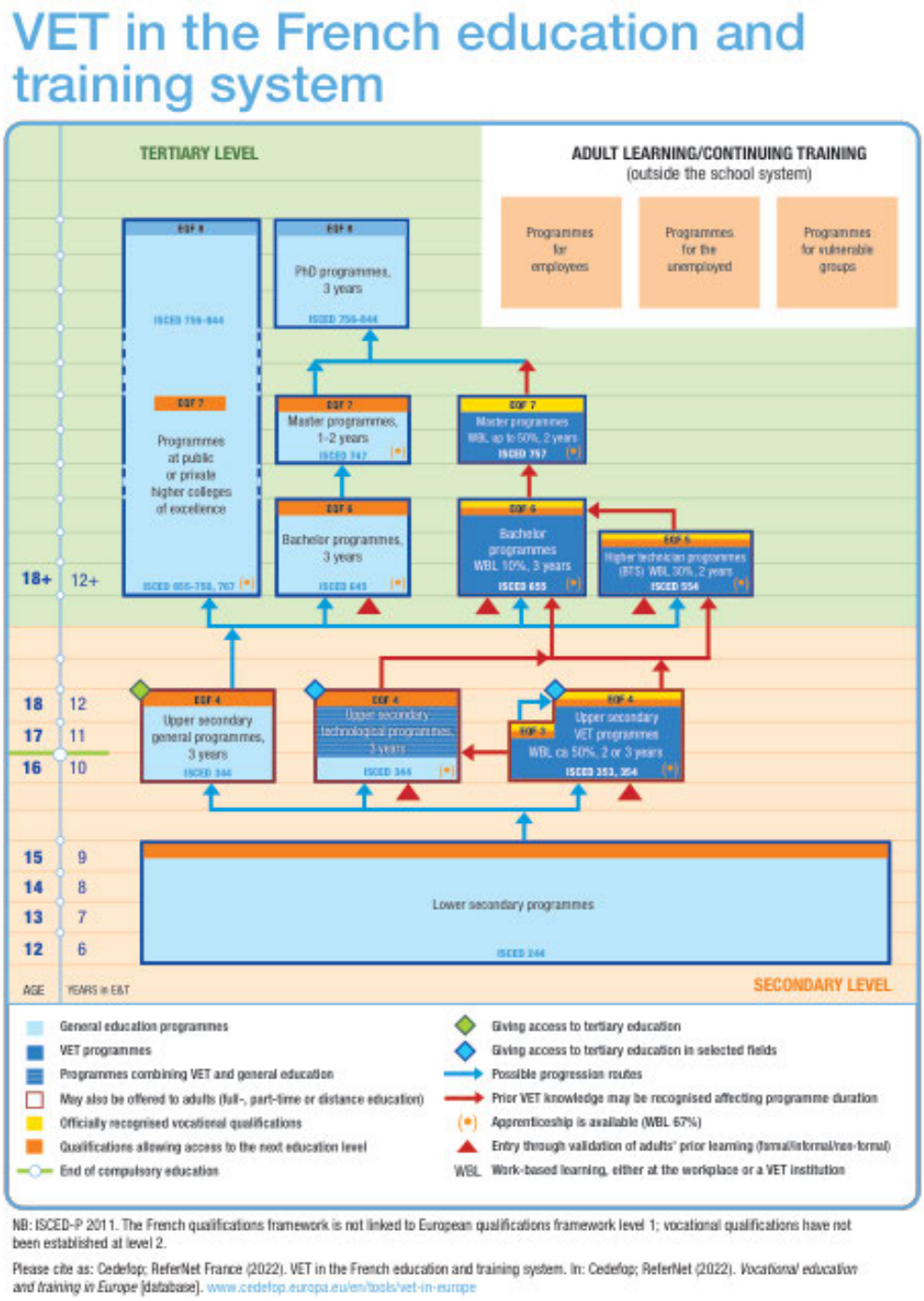
Appendix 4: Diagram showing the outline of the UK's Educational Vocational Training system (subject to changes within England, Scotland, Wales and Northern Ireland)



Description of the framework may be found at: Cedefop; Vocational Education and Training United Kingdom System Description. Available at:

https://www.cedefop.europa.eu/en/print/pdf/node/34117

Appendix 5: Diagram showing the outline of the French Educational Vocational Training system



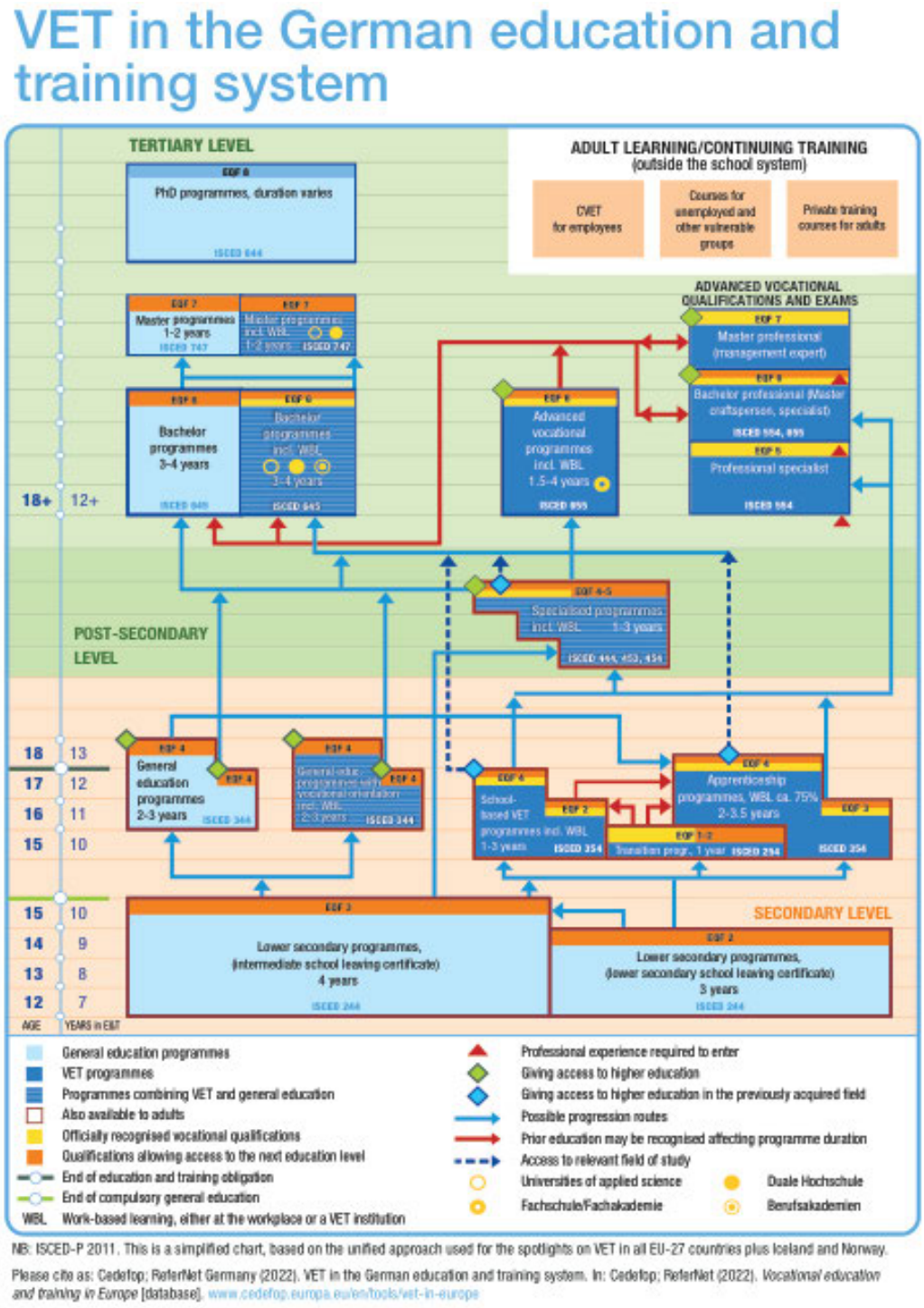
NB: ISCED-P 2011. The French qualifications framework is not linked to European qualifications framework level 1; vocational qualifications have not been established at level 2.

Please cite as: Cedefop; ReferNet France (2022). VET in the French education and training system. In: Cedefop; ReferNet (2022). *Vocational education and training in Europe* [database]. www.cedefop.europa.eu/en/tools/vet-in-europe

Full Description of the framework may be found at: Cedefop; Vocational Education and Training France System Description. Available at:

https://www.cedefop.europa.eu/en/print/pdf/node/156485

Appendix 6: Diagram showing the outline of the German Educational Vocational Training system



NB: ISCED-P 2011. This is a simplified chart, based on the unified approach used for the spotlights on VET in all EU-27 countries plus Iceland and Norway.

Please cite as: Cedefop; ReferNet Germany (2022). VET in the German education and training system. In: Cedefop; ReferNet (2022). *Vocational education and training in Europe* [database]. www.cedefop.europa.eu/en/tools/vet-in-europe

Full Description of the framework may be found at: Cedefop; Vocational Education and Training Germany System Description. Available at:

https://www.cedefop.europa.eu/en/print/pdf/node/156363

Appendix 7: Topics for Conversations between Apprentice, Educational Institute, Employer and Relevant Government Agency

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The following is a series of suggested topics and content for inclusion in a ‘*Conversation of Mankind*’ between all the stakeholders in Apprenticeship Programmes.

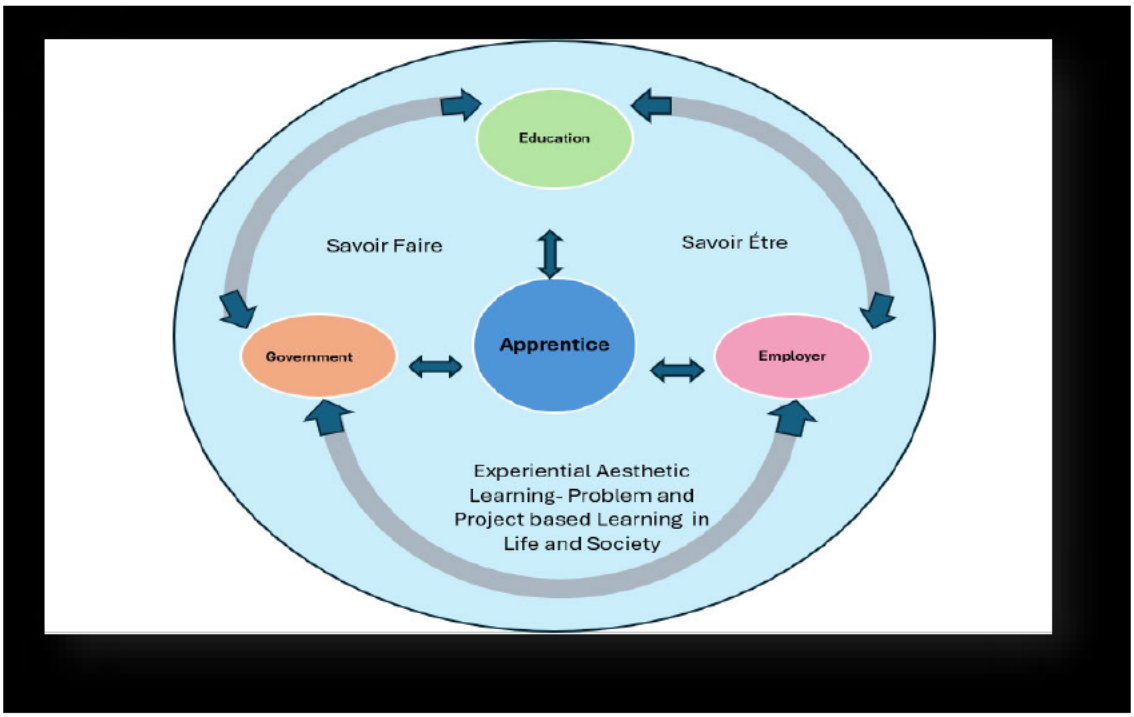


Diagram showing Oakeshott’s Conversation of Mankind combined with Méhout’s Savoir Faire and Savoir Être – a basis for the conversational topic.

1. The Apprentice - In conversation:

With the Employer would discuss:

The assurance of a Full Apprenticeship programme to include:

- Offering a *full range of duties* with a skilled/trained craftsman or woman to facilitate qualification requirements on completion of proposed duration of apprenticeship.
- Entry level payment to be in line with state’s minimum wage agreements with employers – (maybe less as apprentice is in a’ learning capacity’ – but should allow an apprentice to have a living wage).
- Progression ladder from beginner’s level to fully qualified level with remuneration for each progressive year.

- Full training on Health and Safety conditions and recommendations within the workshop/industry settings – including use of tools, machinery and protective clothing and equipment.
- Opportunity to avail of a full time position with the local employer (or within the skill/craft organisation) on successful completion of apprenticeship.
- Compliance by employer to release apprentice on *agreed dates* for attendance at educational institutions (enables apprentice to be included in a familiar group when attending college – part of a team and each on the same level of learning).

With the Educational Institute would discuss:

The assurance of a Full educational programme to include:

- The provision of a programme of education to supplement and enhance the skill/craft under study – may also include provision of activities outside range of theoretical studies e.g. art and design, communications, information technology etc.
- Entry to a full range of educational institution's facilities e.g. clubs, societies, health and wellbeing providers, additional learning facilitators in college etc.
- The assurance that the award for successful completion of the apprenticeship programme is nationally and/or internationally recognised and is on a National Framework of Qualifications (levels associated with specific qualifications).
- The provision of a progressive ladder to Higher Education or Further Educational studies on completion of a specified standard of qualification for the programme under study.

With the Government Agency For Apprenticeships would discuss:

The assurance of Full State Registration of Apprenticeship to include:

- State registration as an apprentice on a particular apprenticeship programme to include entry year, employer's details, apprentice's personal registration details etc.
- State's guarantee of provision of a placement with an educational institute near to employer's location (payment of a subsistence allowance if apprentice has to travel or reside in another location to attend college).
- Provision of a mediation service with professional providers for apprentice, employer and educational institute in cases of dispute over conditions of apprenticeship (all parties to be included in apprenticeship agreements).

- Full qualification registration on successful completion of apprenticeship programme of study.

1. The Educational Institute – in conversation:

With the Apprentice would discuss:

- Full provision of theoretical and practical knowledge to inform and enhance the apprenticeship programme under study.
- Provision of fully qualified lecturers/teachers/trainers to provide instruction, organise practical workshops, encourage critical thinking and develop individual growth along with group participation in project and problem based learning activities.
- Offer full college facilities to complement apprentice's learning – to include access to classes outside the range of the curriculum or to be included as 'electives' on the transcript of classes taken in college and eligible as a credit in accumulating credits for full qualification. (Credit accumulation of subjects studies would require Educational Institutes' approval for inclusion in transcript for full qualification – but may still be added as an extra credit).
- Offer a route to further learning or Higher Education on successful completion of apprenticeship programme – recognition of qualification on National Framework of Qualifications.
- Provide a forum for meeting with other like-minded individuals studying for the same or similar qualification but in separate employments (provides a network and basis for inclusion in a community of learning).
- Provide a forum for meeting and studying with individual outside the apprenticeship programme – other college students on campus from different disciplines.
- Provide a forum for the transfer of ideas/problems/collaborations between the workplace and educational arenas and vice versa.
- Provide the apprentice with a different educational experience from that of a second level school – encouraging critical thinking skills and self-development.
- Provide the apprentice (wither young or mature student reskilling or upskilling) with a forum for growth at a level of education geared towards young adults and adults with prior work experience and maturity.
- Provide the apprentice with a 'Microcredential' replacement for an element of study not within the student's ability. This would be a substitute element which would be recorded

on the transcript of achievements on completion of the full course of study in place of traditional/normal modules.

With Government (or Stage Agency for Apprenticeships) would discuss:

- Registration with Stage Agency and agreement to provides the full range of skills and education necessary to comply with the standards required for completion of a successful apprenticeship programme (may require conversations with employers and others involved in setting the standards and topics/modules being designed – curriculum content and development).
- Design and development of exam schedules and arranging timetables and group numbers for inclusion in apprenticeship programmes in college for different levels of apprenticeship.
- Act in conjunction with the agency to provide and facilitate the apprenticeship programme's uniformity of subjects under study showing levels of progression from beginner to advanced. This would facilitate movement of apprentices between different work and learning locations if necessary.
- Microcredential achievement in place of traditional/normal modules in study programme to be registered as acceptable for a full award on completion of study.

With the Employer(s) would discuss:

- As there may be a multitude of employers involved in different programmes of study the solution would be to offer an invitation to all employers to submit specific requests for educators to include modern operational instructions when developing apprenticeship programmes – the theories will always be constant but the techniques and tools in the real world may change and modernise (an area difficult for educational institutions to keep up with in view of the costs involved). However, networking and arranging classes by visiting lecturers in real workplace environments (as opposed to classrooms, or educational workshops) may resolve the problem and constitute a real working relationship between employer and educational institution.

2. The Employer – in conversation:

With the Apprentice would discuss:

- A stipulation to abide by the rules and regulations of the apprenticeship programme especially with regard to health and safety requirements, timekeeping and diligent

attention to working in a team environment with projected deadlines and time constraints.

- A request that on completion of an apprenticeship programme the apprentice would consider remaining with the employer for a specified period in order for the employer to recover the initial outlay of costs incurred in the apprentice's training programme. This could be included into a contract for consideration in the final year of the programme.
- The apprentice would participate in collaborative projects with the educational institution and the employer. This would facilitate new learning and work practices in a joint venture to improve working relationships between both and enhance the apprentices' learning opportunities in both environments – project based and problem based learning.

With the Educational Institute would discuss:

- A consultation or outline on proposed curriculum content for the apprenticeship programme for their apprentices – to evaluate when and where to locate their own learning criteria and practice to coincide with the institutes programme.
- An outline of times and dates to co-ordinate their own workforce to align with the loss of the apprentice (especially at higher levels of apprenticeship) when the apprentice is almost a fully trained employee and a necessary part of the workforce.
- A request to work in tandem with the institute to solve problems in the workplace requiring the skill and professional development of the apprentice and to provide a working relationship with the institute.

With the Government (agency) would discuss:

- Allocation of funding to help in the provision of apprenticeship programmes – which are costly on the employer as they provide mentors who are skilled workers to take time from their own tasks to teach a new skill.
- A request for funding to offer 'part time' programmes to their workforce through the educational institutes which would enable them to upskill or reskill qualified apprentices in specialised areas of training.

3. **The Government (agency for Apprenticeship) – in conversation**:

With the Apprentice would discuss:

- A commitment for the apprentice to complete the apprenticeship in a diligent and timely manner.
- Would agree to support the apprenticeship programme by marketing and advertising the Government's commitment to support apprenticeship programmes
- Provide extra funding to support apprentices who may be employed by small crafts organisations in learning crafts and skills that are at risk of becoming obsolete.
- Provide funding for individual apprentices who would have to travel and reside in locations away from their place of employment and/or educational institute

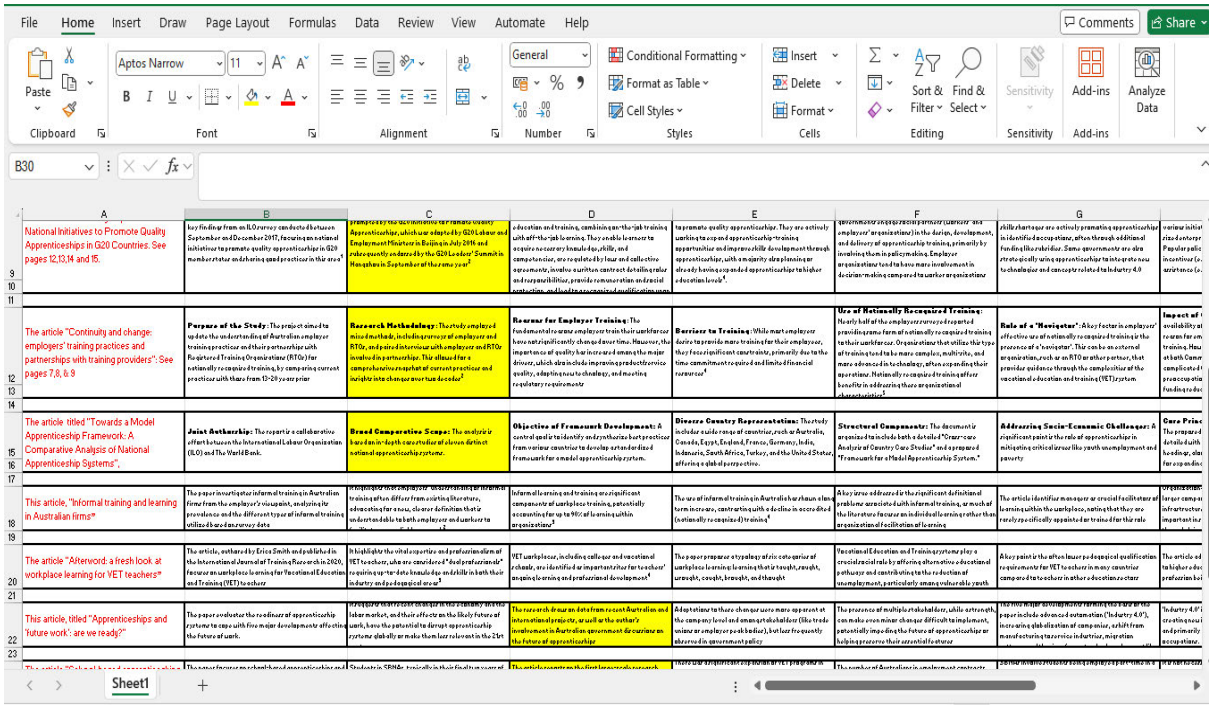
With the Educational institute would discuss:

- Provision of funding to purchase modern materials and equipment necessary for the teaching and learning of skills and crafts
- Provision of funding to employ professionally qualified teachers (with necessary skills and teacher training qualifications).
- Provision of advertising programmes to link apprenticeships with routes to Higher Education learning
- Provision of apprenticeships in skills necessary for humanity's future in areas of climate change, sustainability of the earth's resources and many other areas where academic knowledge can be enhanced by hands on skills and human interaction and intervention.
- Microcredential criteria for inclusion in apprenticeship programme.

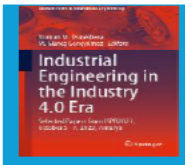
With employer would discuss:

- Advertising and funding apprenticeship programmes in diverse areas – to include small businesses and crafts/skills necessary for future growth and development e.g. the inclusion of Artificial Intelligence in the workplace and the concept of symbiotic relationships with humans and machines.
- The provision of funding for upskilling and reskilling of employees to cope with industry's competitive markets if society needs the industry e.g. reliance on foreign manufacturing for paper masks during the Covid pandemic.
- Re-imbursement of costs required to run apprenticeship programmes – some employers may be offered incentives to engage with apprenticeship programmes e.g. tax deductions, initial per capita imbursements for 1st year apprentices, etc.

Appendix 8: Screen snapshot of Excel spreadsheet outlining list of publications by Erica Smith and colour code for specific content location – example methodology



Appendix 9: Details of Publications Numbers 1-5 (as outlined in Chapter 1)



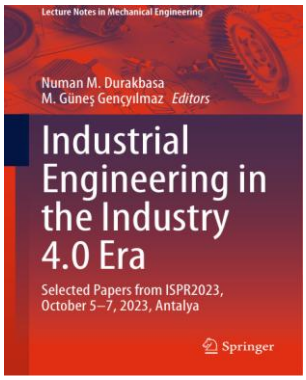
Springer: https://doi.org/10.1007/978-3-031-53991-6_18

The Global Apprentice: Adaptive, Versatile and a Lifelong Learner.

By: Breda Walsh Shanahan[1], Mary Doyle-Kent[2]

Design/methodology/approach	Secondary source research from peer reviewed publications/papers
Findings	Describes the urgent need for new skills in the workforce resulting from Industry 4.0
Research limitations/implications	Looks at soft skills – lifelong learning requirements for Industry 5.0
Practical implications	Combines stakeholders aspirations from Industry, Government, Learners and Educational Institutions
Social implications	Outlines need to attract and retain top talent, to communicate knowledge and create an environment which nurtures growth and creativity
Originality/value	Addition to knowledge – shows important link between learners – industry – government – educational institutions
Keywords,	Education, Mentoring, Macro and Micro-credentials, Lifelong Learning, Global Apprentice, Industry 4.0, Industry 5.0.
Paper type	*Conceptual – Teaching Material Book Chapter*
Abstract	Today's work environment demands high-performance teams comprising diverse, multi-disciplinary workers with lifelong learning skills that are educated in a manner that will equip them to understand and combat the crises we face. These teams must be capable of adapting and solving present and future problems of our growing population while safeguarding our planet and its resources. This paper presents the findings of two European studies emphasising the importance of education and training in enabling current and future workers to engage with new technologies and new learning. It proposes an educational model based on collaboration between Higher Education institutions, Industry and Commercial companies and learners. It presents the skills required to ensure a successful transition to Industry 5.0 and defines how the four pillars of evolving education. a) Macro credentials, b) Micro credentials, c) Mentoring and Equality, d) Diversity, Belonging and Inclusion, hold specific characteristics designed to meet the challenges of the future workplace.

Publication 1 is offered here in full. Access to the publication is behind a paywall.



The Global Apprentice: Adaptable, Versatile and a Lifelong Learner

Breda Walsh Shanahan[a,1], Mary Doyle-Kent[b,2]

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Abstract— **The future of humanity itself depends on how we adapt to the existential crises we face such as global warming and the loss of biodiversity. Today's work environment demands high-performance teams comprising diverse, multi-disciplinary workers with lifelong learning skills that are educated in a manner that will equip them to understand and combat the crises we face. These teams must be capable of adapting and solving present and future problems of our growing population while safeguarding our planet and its resources. This paper presents the findings of two European studies emphasising the importance of education and training in enabling current and future workers to engage with new technologies and new learning. It proposes an educational model based on collaboration between Higher Education institutions, Industry and Commercial companies and learners. It presents the skills required to ensure a successful transition to Industry 5.0 and defines how the four pillars of evolving education. a) Macro credentials, b) Micro credentials, c) Mentoring and Equality, d) Diversity, Belonging and Inclusion, hold specific characteristics designed to meet the challenges of the future workplace.**

Keywords— **Education, Mentoring, Macro and Micro-credentials, Lifelong Learning, Global Apprentice, Industry 4.0, Industry 5.0.**

I. Introduction

The need for climate action to reduce biodiversity loss caused by human environmental damage, the complex social inequalities causing poverty and the lack of inclusivity and diversity are recognised as the existential threats facing humanity in 2023 and beyond. These challenges are further intensified by widespread instability following the Covid-19 Pandemic. Consequently, society and the world of work has changed. Social, environmental and scientific advances have created different workplaces for employees, businesses, governments, educators and society and while some changes bring improvements there are also disruptions and losses to the jobs market where new skills are essentially required by the workforce. Today's work environment demands high-performance teams comprising diverse, multi-disciplinary workers with lifelong learning skills. These teams must be capable of adapting and solving present and future problems of our growing population while safeguarding our planet and its resources.

Prior to the pandemic the European Union (EU) publication Breque et al. in 2021, described how inter-connected the future of Industry 5.0 and emerging social trends will need to interact and co-exist as Industry 5.0 complements and extends the hallmark features of Industry 4.0. It emphasises factors that are not just economic or technological in nature, but also have important environmental and social dimensions.[1]

II. Smart Manufacturing and Industry 4.0/Industry 5.0

As Industry 4.0 and its inclusive technologies are connected to the Internet of Things (IOT) it follows that all the data that is being generated by connected sensors can be captured, processed and used to optimise processes and factories. One of the main goals of these developments is a "smart factory" being able to produce economically "Lot Size One". This new smart way of manufacturing has become a revolution by the increasing levels of automation, cyber physical systems, digital twins and the intensive use of data analytics. [2] The synchronisation

of humans with robotic systems and the need for Science, Technology, Engineering and Maths (STEM) life-long learners, with a mixed disciplinary approach to learning, is now more urgent than ever.

The Community Research and Development Information Service (CORDIS) is the European Commission's primary source of results from the projects funded by the EU's framework programmes for research and innovation. They emphasise the importance of multifaceted approaches to learning from two studies coordinated in Norway by Sintef AS and in Italy by the Universita Degli Studi Di Modena E Reggio Emilia from 2016 to 2019 [3]

- The HUMAN study conducted in Norway emphasizes the importance of workers with specific skills, experience, competences, and flexibility in the successful adoption of automation solutions by European Union (EU) manufacturers. It acknowledges the need for a cooperative environment that effectively utilizes and nurtures workers' capabilities and knowledge. Integrating automation and robotics is crucial for achieving productive growth, but it must prioritize the safety of workers and value their cognitive and physical abilities.

- The INCLUSIVE study, conducted in Italy, focuses on the complexity of modern automatic machines and robotic cells in production plants. With the increasing demand for faster production rates, Human Machine Interfaces (HMIs) have become essential tools for human operators, engineers, technologists, and scientists. However, the constant updates and intricate nature of these HMIs can present challenges for operators, especially when considering factors such as age and ability. The primary goal of the study is to investigate how the human-machine interface can be modified to accommodate the capabilities of the operators. This objective revolves around three main pillars: assessing operator capabilities, adapting the HMI accordingly, and providing training and support to operators.

Both studies stress the crucial role of education and training in enabling workers to effectively collaborate with the rapid advancement of automation and robotics in production plants. A workforce that possesses the necessary skills and knowledge to operate and interact with these technologies is not only desirable but is essential for future economic growth and productivity.

The imminent paradigm shift in manufacturing and production, known as Industry 5.0, is rapidly approaching. This new era is characterized by a focus on personalization and customization, the two key elements highlighted in the EU studies HUMAN and INCLUSIVE. The HUMAN study proposes enhancing human/computer interaction by educating individuals about system requirements, while the INCLUSIVE study suggests improving computer/human interaction by adapting software and mechanisms to human ergonomics. Both studies revolve around the central theme of new knowledge acquisition and training.

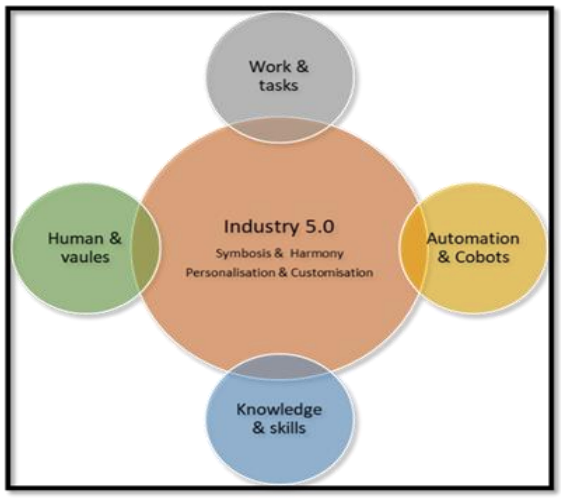

Figure 1. Conceptual framework illustrating Industry 5.0 [4]

In narrative terms, enhancing the above diagram, Doyle-Kent states*: "Industry 5.0 is the human-centered industrial revolution which consolidates the agile, data driven digital tools of Industry 4.0 and synchronises*

them with highly trained humans working with collaborative technology resulting in innovative, personalised, customised, high value, environmentally optimized, high quality products with a lot size one." [4]

III. The Global Apprentice

A key question in achieving a successful transition to Industry 5.0 is: "How can we effectively train and retain multi-skilled STEM workers, equip them with diverse learning abilities, and empower them to be lifelong learners with transferable qualifications?" In essence, the goal is to foster a mindset and create a "Global Apprentice". Becoming a "Global Apprentice" encapsulates the aspiration to be globally competitive, equipped with a diverse range of skills, and capable of applying knowledge in various contexts. It signifies a commitment to lifelong learning, adaptability, and the pursuit of excellence in an interconnected and rapidly changing world.

To resolve the problem of attaining knowledge and training the approach outlined here draws upon theories from various fields such as education, business, engineering, and psychology. It proposes an amalgamation of Higher Education macro credentials, micro credential learning, mentoring programmes and an awareness of diversity, equality, belonging and inclusion (DEBI). This collaborative approach offers a solution that benefits humans, technology, robotics, economics, and society. It advocates for a threefold inclusive partnership among Higher Education institutions, Industry, and the Lifelong learner, each contributing unique strengths and values [5] The partnership involves:

1. Higher Education and Training Institutes: The institutions that serve as providers of knowledge and skills.
2. Industry and Commercial Companies: The competitive markets that deliver products and services through employment, social/environmental involvement and wealth creation.
3. Employees/Learners: The individual members of society who earn a wage and strive for personal growth.

Human capital, not financial, is the most important asset available to any successful company. A critical requirement of a modern manufacturing environment is to attract and retain top talent, to communicate knowledge and create an environment which nurtures growth and creativity. [4] The main problem requiring employees to return to education or to engage with new learning is often based in the way the 'new training' or 'education' is delivered or on the employee's negative learning experiences of the past, time commitments or personal reasons for non-engagement. [6]

IV. Current Educational Models

In 1972 Malcolm Knowles developed the theory of Adult Learning on four main assumptions which are as important today as they were 50 years ago. Knowles' four main assumptions on adult learning are: Changes in Self Concept, Role of Experience, Readiness to Learn and Orientation to Learning. Each of the assumptions has a place in new learning experiences and each holds personal value for the learner in various degrees of importance. [7]

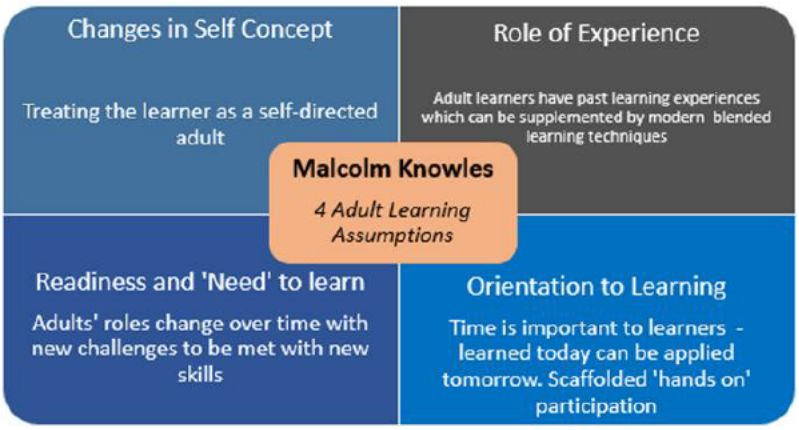

Figure 2. Interrelated learning assumptions from Malcom Knowles. [7]

In the evolving landscape of industries, where dynamic work practices align with scientific and technological advancements, the pursuit of quality educational models has also experienced dynamic changes. While obtaining a 3 or 4 year undergraduate degree from a university remains a highly esteemed achievement for individuals and society, the methods of attaining such credentials have evolved. This macro-credential serves as evidence of intelligence and focused study in a chosen professional field. Traditionally, holding a degree has provided individuals with opportunities to embark on careers, entrepreneurship, or further education. The recognition of degrees is universally acknowledged, with transparent learning outcomes established through Higher Education (HE) programs and educational standards regulated by authorities and ministries in developed and developing countries. [5]

However, there is overwhelming evidence that many current models in higher education will not be able to meet a growing demand for a depth and breadth of new skills and competences across multiple sectors or for the jobs of tomorrow. It is predicted that 50% of all employees will need reskilling by 2025 and widely accepted that over the next decade "...new technologies will reshape millions of jobs in the EU." [8]

In 2018 Deloitte and The Manufacturing Industry listed the main skills required for future manufacturing success [9]. Including these skills into modern educational courses is a challenge which has been met in many instances through the attainment of long term macro and short term micro credentials.

Table I: The Top Ten Skills Required for Future Manufacturing. [9]

Digital literacy as a holistic skill to interact with, understand, enable, and even develop new digital manufacturing systems, technologies, applications, and tools
Ability to use and design new AI and data analytics solutions while critically interpreting results
Creative problem solving in times of abundant data and technological opportunities in smart manufacturing systems
A strong entrepreneurial mind-set including pro activeness and the ability to think outside the box
Ability to work physically and psychologically safely and effectively with new technologies
Inter-cultural and -disciplinary, inclusive, and diversity-oriented mind-set to address new challenges arising from a more diverse manufacturing workforce

Cybersecurity, privacy, and data/information mindfulness to reflect the rapidly increasing digital footprint of the manufacturing value chain
Ability to handle increasing complexity of multiple requirements and simultaneous tasks
Effective communication skills with humans, IT, and AI systems through different platforms and technologies
Open-mindedness towards constant change, and transformation skills that constantly question the status quo and initiate knowledge transfer from other domains

The attainment of the skills listed above are becoming mandatory for the future successes of the individual and the manufacturing industry. The following outlines four pillars of evolving education, each with inherent characteristics, designed to meet the challenges of the future workplace: *A.* Macro credentials, *B.* Micro credentials, *C.* Mentoring and *D.* Equality, Diversity, Belonging and Inclusion.

V. Educational Models

Content-laden macro degrees, whilst valued in the long term, are not always effective for adult learners in today's fast paced environment. Employees and employers need 'just-in-time' skills that are immediately applicable and easily attainable. This trend is likely to accelerate with the economic crisis triggered by the COVID-19 pandemic. [10] The efforts of Higher Education Institutes, Industry and Governments are shown below as examples of what is being done and what can be achieved with collaboration and creativity.

A. Macro Credentials

In 2019 Costello et al. described a case study in an Irish bio-medical company where the company's engineers acted as educators to upskill the current technical workforce. [6] The criteria for this 'in house' training system was to develop a low cost, adaptable structure of upskilling whilst catering for different employee operational work shifts. As a result of this action research study the following challenges were recognised as some of the main project learnings:

1) Reluctance by technicians to learn from engineers who were not teachers. 2) Attendance was low and sporadic due to shift work. 3) 'Off site' was preferred by learners/Older technicians not engaging with new learning compared to younger technicians. 4) Lack of IT knowledge and fear of new learning techniques. 5) Technicians not happy with 'Book Learning' preferred practical learning. 6) Essential 'Communication and Information Technology Skills' studies were not included in the industry training programme.

Following on from the findings of this industry initiative researchers in a third level technological university saw the opportunity to create an alternative training model which is outlined in their paper 'The development of a novel educational model to successfully upskill technical workers for Industry 5.0: Ireland a case study'. The research was interpreted to offer a new course of instruction for upskilling engineers and engage with modern blended learning techniques, a college environment, and professional educators from diverse engineering, technology and humanities disciplines at a pre-university level. [11]

Another example of a university engaging with large corporations and small and medium size enterprises is shown in the study in 2022 by Kopacek and Doyle-Kent who described the success of the Technical University of Vienna (TUWien) and the Oakland University of Rochester (Michigan, America) who co-operated in a joint MSc in Engineering Management programme beginning in 1995. The successful programme has over 25 years of experience, runs as part of the Bologna Convention which encourages integration between higher education and industry, is an international collaboration with content updated regularly and the graduates continue into higher management or have founded their own companies. [12]

B. Micro Credentials

Micro-credentials, as defined by the European Commission, serve as *proof of learning outcomes* acquired through short learning experiences and follow transparent standards. [10] Examples of micro-credentials can be obtained from providers such as FutureLearn, Microsoft, Coursera and edX. These credentials are available online or through a blended teaching techniques based on Massive Online Open Courses (MOOCs). The design and delivery of courses leading to micro-credentials can vary in length, difficulty, workload and assessment practices. To ensure transparency and informative communication, micro-credentials should include essential information such as the title, learning outcomes, content description, assessment type, and quality assurance. The portability and stackability features of micro-credentials play a significant role in their global acceptance and success. [5]

Table 2: Micro-Credentials – Common Characteristics [13]

Micro-Credentials – Common Characteristics	
1	Limited length of learning activities – larger than a single course but less than a degree
2	Labour market relevance: focus is on delivery of specific knowledge, skills, and competences useful in the workplace
3	Wider societal impact: focus on lifelong learning opportunities that are reasonably priced, short and convenient to access.

The recognition, *validation and value* attributed to micro-credentials are crucial for their acceptance in the workplace, by employers and learners. To establish this recognition, micro-credentials can align with formal criteria used in degree programs, known as "credits." These credits are based on the estimated and agreed time a learner must spend on a specific element of study, as defined by the European Credit Transfer and Accumulation System (ECTS). The ECTS system is adopted by 48 countries in the European Higher Education Area. This transferability allows for international acceptance of qualifications leading to a truly Global Apprenticeship.

In designing programmes to include Micro-credentials Hudak and Camilleri offer two recommendations to Higher Education Institutes which benefit all three stakeholders – the HE institutes, the employer and the learner (including future learners). [14]

Recommendation 1 - Micro-credentials should be developed with partners from outside academia wherever possible and are most successful when they are reflections of academy-industry partnerships.

Recommendation 2 - Micro-credentials should be used to increase flexibility and innovation as they are smaller-scale than full degrees, and micro-credentials have fewer standardized requirements. Thus, micro-credentials are often more easily fundamental to innovation.

Aligning Higher Education quality assurance standards to micro-credentials ensures the standards of the HE institute are aligned with the micro-credentials as assessment forms the essential component of a qualification and Ireland is one of only three countries within the EU who have the independent authority to include and authenticate their own higher education programmes – the others are Norway and Finland..[15] In 2020 the European Commissioner Ursula Von der Leyen stated, "The best investment in our future is the investment in our people. Skills and education drive Europe's competitiveness and innovation. But Europe is not yet fully ready. I will ensure that we use all the tools and funds at our disposal to redress this balance." [16]. This statement was prompted by figures which showed between 2008 and 2018 Industry accounted for 20% of EU GDP [17] and Manufacturing provided 14.5% to the EU economy. [18]

There are many countries throughout the world investing huge capital resources to achieve the goal of creating a lifelong learner and a global apprentice through the introduction of micro credentials. Research by Walsh Shanahan and Organ in 2022 outlines the efforts of the Irish and Australian government's initiatives to combat the effects of the Covid-19 pandemic, job losses, new technologies entering the workforce and the need for new skills. Ireland's 'Human Capital Initiative (HCI)' focuses on seven Irish universities engagement with industry to progress changes in educational methods to enable learners to re-skill, up-skill or change careers [5] [19]. The Australian Federal Government reviewed their Qualifications Framework in 2020 following a study which

showed that 2.6 million people engaged with non-qualification courses to meet industry requirements with over 90% of the training market being provided by private companies without government assistance. [20] [5]

C. Mentoring

Traditionally, mentorship in industry has often involved 'apprenticeships' or 'on-site' learning following initial training. In this approach, a seasoned and knowledgeable mentor is assigned to guide and teach a younger or novice individual, imparting the skills required for the position. Through mentoring experiences, students learn to combine their foundational knowledge with shared or role-modelled experiences. [21] The following outlines an evolved version of the mentoring model to cater for evolving and dynamic work practices which can be passed up and down through the all-inclusive professional chain allowing new ideas, technologies, creative problem solving to be introduced at all levels.

I) Mentoring Models: Mentoring can take different forms, and its effectiveness depends on the context and goals involved. One way to conceptualize mentoring is through a hierarchical model, where the primary emphasis is on achieving specific outcomes such as knowledge transfer, continued learning, and professional assimilation. This model is often observed in fields like medicine and scientific professions, where experienced individuals share their expertise with less-experienced mentees in a top-down manner. However, the collaborative model of mentoring values the contributions of both mentors and mentees. By embracing the collaborative model, mentoring becomes a two-way process that goes beyond the mere transfer of knowledge. It creates an environment that nurtures innovation, creativity, and the exploration of new ideas. This approach can be particularly beneficial in fields where multidisciplinary collaboration and adaptability are essential, as it encourages mentees to become active participants in their own learning and professional growth. [21]

Warner presented a multi-level "Mentoring Ladder" where the influence of mentors drawn from higher levels to mentors trained and deployed at all levels. [22]. A working example of this model is seen in The University of Michigan's College of Engineering Peer Mentoring Program which matches new students with mentors who are recruited from senior engineering students based on common interests. Santora, Mason and Sheahan presented the model, seen here in Fig.3, outlining the levels of mentoring intensity in operation between each student and mentor. [23]

Mentees, regardless of gender, can experience objective and attitudinal benefits from mentoring. [24] *Objective benefits* encompass positive career planning, increased career involvement, higher income, and more promotions. *Attitudinal benefits* include job and career satisfaction, as well as career commitment. It is often noted that formal organizational mentorships can be less effective than informal ones due to factors like personality conflicts, the need for external support, and insufficient commitment from either party. Nevertheless, organizations have been implementing formal mentoring programs to match mentors and mentees, aiming to capture the qualities of successful mentoring relationships. It is important to note that, on average, formal mentoring programs tend to yield better results than having no mentoring at all.[25]

Mentoring and gaining experience significantly increases the opportunities for the Global Apprentice to combine varied work practices with new technologies, remaining current and relevant in their professions within a diverse and inclusive workforce.

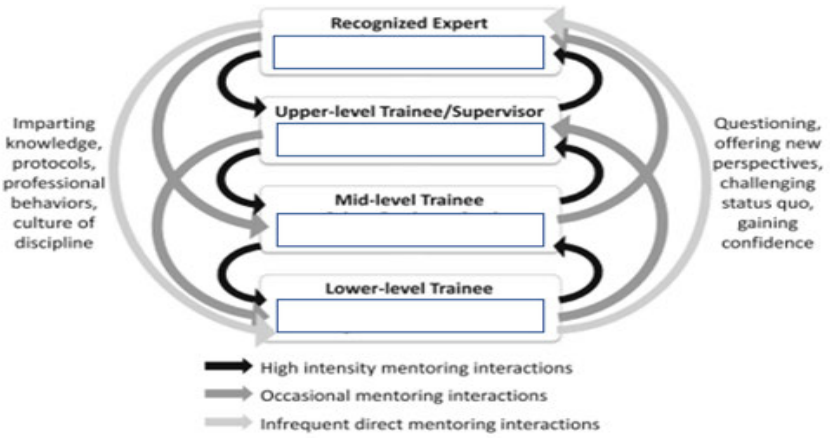

Fig. 3. Progressive Mentoring Model [23]

D. Diversity, Equality, Belonging and Inclusion (DEBI)

High performance teams working in all areas are required to address the global crises. It is widely accepted that an inclusive and diverse workplace inherently attracts top talent that outperforms homogenous teams. Women and other minority groups are often underrepresented in Science, Technology, Engineering and Maths (STEM) globally especially in key areas of engineering and manufacturing. [26] [27]. In 2022, Doyle-Kent and Kopacek wrote about Optimising Human Potential through Diversity and Inclusion. They wrote about the future of industry in Europe which incorporates three dimensions; the regenerative dimension, the social dimension and the environmental dimensions and state that "Traditionally equality, diversity and inclusion (EDI) was not seen as an important consideration in technological work environments. Engineering companies now realise that if they want to have a competitive advantage globally, then their employees need to be the brightest and best." They conclude that to future proof the workplace ensuring the brightest and best can be recruited and retained, it's critical that the workplace is, inclusive and equitable and that the employees will need to feel that they belong to thrive and reach their full potential. In turn this will bring the competitive advantage to the company and ensure long-term survival. [28]

VI. Conclusions

The main goal for Industry 5.0 is founded on 'human progress' and the best possible pathway to achieving this is through education and training, attaining new skills, upskilling existing work practices and engaging in continuous lifelong learning. This paper is based on current international scientific research from both commercial and educational sectors and outlines the characteristics necessary for human engagement with new technologies and robotic interaction. The four pillars of dynamic lifelong learning are shown here to provide educational opportunities in creating the 'Global Apprentice' through engagement with macro credentials, micro credentials, mentoring practices and being aware of the sense of belonging which can be fostered by colleagues who are people of all genders, ages, race and diversity. The diverse interaction of human skills, practices and cultures has the potential to create a community of collaboration with shared goals, the ability to find sustainable solutions, and advance positive social impact. Future education for the success of Industry 5.0 must include several facets to include industry-oriented curricula, mentoring relationships, micro credentials and a willingness from all parties to promote the sustainability of our resources and the regeneration of our planet for the following generations.

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Publication 2

ScienceDirect- Elsevier ***https://doi.org/10.1016/j.ifacol.2022.12.072*** **By Mary Doyle-Kent, * Breda Walsh Shanahan****	***The development of a novel educational model to successfully upskill technical workers for Industry 5.0: Ireland a case study***
Design/methodology/approach	A review of literature - through secondary peer reviewed sources – based on action research results by author
Findings	A new model for upskilling workers – new teaching methodologies – blended learning
Research limitations/implications	Currently in process of introduction
Practical implications	Practice curriculum, practice pedagogies and personal epistemology.
Social implications	A means of upskilling workers with online/college education and professional teachers using blended learning techniques
Originality/value	Taking on site training into a 3rd level college
Keywords,	Education, Andragogy, Industry 4.0, Industry 5.0, Learner centred education, programme design, educational theorists, engineering technicians
Paper type	*Conceptual paper*
Abstract	*The aim of this research is to describe how, in Ireland 2022, a new andragogical educational model for adult learners from industry was designed to meet the need to upskill established technical workers. The programme is designed to meet the dynamic requirements of Industry 4.0 and Industry 5.0 and has been established by primary and secondary research. The newly designed programme addresses the need for improvement and growth of current teaching and learning models in technical education.*

Publication 3

ScienceDirect- Elsevier https://doi.org/10.1016/j.ifacol.2023.10.107 **By Breda Walsh Shanahan, * Mary Doyle-Kent****	***Mentorship in Engineering: Women, Inclusivity and Diversity*** ***– A challenge for our times***
Design/methodology/approach	Secondary source research from peer reviewed papers
Findings	Women's numbers in industry low compared to graduate numbers of women in STEM
Research limitations/implications	Looks at the current view of numbers of STEM graduates in Industry – although equality of genders in colleges women not moving into industry
Practical implications	Investigatory – questioning why women are not in Engineering (STEM) in industry
Social implications	Attracting women to STEM subjects
Originality/value	Women in STEM
Keywords,	Industry 5.0, Engineering education, Mentoring, Role models, Diversity and inclusion
Paper type	*Conceptual paper*
Abstract	*Diverse highly talented teams of professionals are needed to work together in order to survive and thrive into the future. There is a recognised crisis in attracting and retaining women and other minority groups into science, technology, engineering, and mathematics (STEM) professions. This paper looks at the statistical representation of women and minorities in STEM professions such as engineering and information technology (IT). Mentorship programmes have been recognised as beneficial and this research outlines the significance played by mentoring and role models in promoting STEM. It analyses how the current initiatives are performing in their efforts to transform and increase participation in STEM.*

Publication 4

ScienceDirect- Elsevier https://doi.org/10.1016/j.ifacol.2024.07.135 By: Ille C. Gebeshuber ∗, Pia M. Graves ∗∗, Inez Wardzinska ∗∗∗, Ruth Mateus-Berr ∗∗∗∗, Breda Walsh Shanahan ∗∗∗∗∗	***Interdisciplinary Approaches in Engineering Education: Preparing Young Minds for Complex Challenges***
Design/methodology/approach	Secondary source research from peer reviewed publications/papers and report of interdisciplinary action research project
Findings	Interdisciplinary and international sharing of knowledge concepts and procedures
Research limitations/implications	College based trial – open to industry if taken up
Practical implications	It bridges the gap between the natural advantages of biogenic materials like mycelium and the technical benefits of manufactured materials,
Social implications	Underscores the importance of future research in materials science for sustainable use throughout society focusing on environmental protection
Originality/value	Interdisciplinary – International collegiality – provides a holistic approach to sustainable development – STEAM (Arts and Sciences)
Keywords,	Engineering education, interdisciplinary research, collaboration, outreach, broader impacts, sustainable model, diversity, inclusion, design thinking
Paper type	*Conceptual paper*
Abstract	*This paper shows the advantages of combining the arts and the sciences ranging from increased resourcefulness to the creation of cutting-edge solutions. By spotlighting best practice examples in both teaching and research, it endeavours to provide a comprehensive exploration of the transformative potential that lies at the intersection of artistic expression and scientific inquiry. The goal is to underscore the many benefits and immense potential that STEAM initiatives hold for the advancement of knowledge, education and innovation.* *Integrating artistic methods into research and teaching makes science more accessible by translating scientific concepts into relatable narratives or vivid visuals, resulting in reaching a more diverse audience. Bridging arts education and STEM education also encourages public engagement since it is more open for dialogue and evokes responsiveness and critical thinking.*

Publication 5

ScienceDirect- Elsevier *https://doi.org/10.1016/j.ifacol.2022.12.015* By Breda Walsh Shanahan *. John Organ**	**Harnessing the Benefits of Micro Credentials for Industry 4.0 and 5.0: Skills Training and Lifelong Learning**
Design/methodology/approach	A review of literature - through secondary peer reviewed sources.
Findings	A history, description and possibilities of introducing Micro-credentials into main stream/vocational/ lifelong education
Research limitations/implications	*currently being offered globally – private purchase mainly- view to integrate into mainstream educational practice*
Practical implications	Practice curriculum, practice pedagogies and personal epistemology.
Social implications	A way of considering the use of micro-credentials and the properties held withing them to upskill and re-skill workers.
Originality/value	A methodology which transcribes time/place/ability to promote online or mainstream educational practices
Keywords,	Micro-credentials, Higher Education, Life Long Learning, Employers, ECTS, Quality Assurance, Framework of Qualifications, Digital Accreditation, Industry 4.0, Industry 5.0
Paper type	*Conceptual paper*
Abstract	Industry 4.0 centered on 'Digitalisation' of the economy and Industry 5.0 will synchronise highly trained humans with collaborative technologies. The Covid-19 pandemic resulted in significant changes in the jobs market with job losses and skills gaps occurring in many sectors. This paper outlines the need for upskilling and lifelong learning to be consolidated into the workforce and the part Micro-credentials play in joining together the three main stakeholders: the learner, the higher education institution and the employer. It offers a description of micro-credentials in today's marketplace and outlines the current research in universities, technological institutes and governments worldwide.

Appendix 11: ResearchGate Statistics on published works as on 22nd September 2025