

EXAMINING HISTORICAL NARRATIVES AROUND ‘HANDS ON’ LEARNING AND INDUSTRIAL EDUCATION

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Abstract

This paper briefly reviews historical narratives of ‘hands on’ learning and Industrial Education as presented by Anderson (1926) and Bennett (1926 & 1937). It is suggested that precedents for some of the contemporary debates in curriculum and pedagogy within Australian Vocational Education and Training have deep roots and their seeds and branches can be found in these historical narratives. For example, in recent years there has been discussion around the development and use of training packages. Training packages are text based specifications of vocational qualifications and as such some VET practitioners and researchers have questioned their effectiveness and whether they constitute a new form of curriculum. This paper specifically focuses on three historical attempts at documenting ‘the mysteries of the trade’. Each is presented as a vignette contextualised through significant events of the time. These are, (1) Moxon’s treatise of 1683, ‘The Doctrine of Handy Works; (2) Diderot’s ‘Encyclopedie’ of 1751, an enlightenment project undertaken in France, that amongst other things documents the trades and industry; and (3) the Russian system of instruction which involves systematic approaches to mechanical instruction in the trades and industry as developed by Della Vos at the Imperial Technical School in Moscow. It is suggested that together these examples stand as ancestors to more contemporary attempts to document trades and occupations as the basis for education and training.

Introduction

‘Hands on’ learning for work has received renewed importance in recent years and this paper reviews some of the historical developments that have occurred in this field throughout the modern era. For the purposes of this paper the modern era is taken to be the period from the renaissance through to the present. This paper draws on secondary educational literature to explore existing narratives in industrial education. In particular, the historical narratives presented by the two educational scholars, Lewis Flint Anderson (1909, 1926 & 1931) and George A Bennett (1926 & 1937), are central. While this body of work by these two American Professors is very Eurocentric they provide a great deal of insight into historical developments in ‘hands on’ learning and industrial education. In fact, many of the threads and variations within contemporary debates in this field can be traced through the historical narratives presented by these writers. Also of importance in this paper is the work of Charles Gillespie (1993), and Philipp Blom (2005) and their various studies of the Diderot’s Encyclopedie of Trades and Industry.

This paper is part of a larger project being undertaken by this researcher which is being guided by four related questions (Brown, forthcoming). These are, (1) what are the historical developments in curriculum and pedagogy for ‘hands on’ learning and

industrial education (Brown 2009); (2) what have been the drivers and purposes of these developments, (3) is there evidence of a negative image for those who work with their hands, in contrast to those who are considered more academic or professional (Applebaum 1992); and (4) what have been the drivers of the tendencies apparent throughout the modern era towards documenting the work of the trades for the purpose of passing this knowledge onto learners and others. This paper explores aspects of Question 4.

The two educational researchers whose work has been reviewed for this paper are Lewis Flint Anderson and Charles Bennett. A snapshot of each is presented next. Lewis Flint Anderson was a Professor in the History of Education at Ohio State University and he wrote a number of histories of various aspects of education, amongst these are his *History of the common school education: an outline sketch* (1909), his biography and discussion of the work of Pestalozzi (1931), and his *History of Manual and Industrial School Education* (1926). The latter of these is a main source for this paper and it should be noted that of the 240 pages of text, the first 132 pages (approx 55%) explain a general and mostly European history of manual and industrial education while the remaining 108 pages discuss the history of manual and industrial education in the USA. Likewise, Charles Bennett was a Professor of Manual Arts, at Bradley Polytechnic Institute and published his *History of Manual and Industrial Education up to 1870*, in the same year as Anderson, 1926. Interestingly, both explain that they think their work is the first of its kind in this field. Both have undertaken considerable translation of original primary sources. Later in 1937, Bennett published a further, companion volume, *History of manual and Industrial education from 1870 to 1917*.

This current paper identifies some of the main actors who have contributed to the fields that make up what we currently understand as ‘hands on’ learning and Industrial Education but focuses mainly on ‘documenting the mysteries of the trade’. Three examples are overviewed and discussed. The first is *The Mechanical Exercises, or the Doctrine of Handy Works*, written and published by Joseph Moxon in London in 1683. The second is the project of publishing the *Encyclopedie* by Diderot, or as the full title translates into English, *Analytical Dictionary of the Sciences, Arts and Trades* – compiled and written by a ‘Society of Men of Letters’. The first volume of ten was published in 1751. The third example is the Russian system of industrial training as developed by Victor Della Vos. It is being suggested that these are forerunners to, and have similarities with, contemporary aspects of Australian vocational education and training such as competency-based training. Specifically models implemented as the Richmond Model in Victoria (Brown 1994), and nationally, as CBT was implemented under the national training reform agenda, and the current rendition which is exemplified through Training Packages (Brown 2003).

Laying the foundations

Anderson (1926) explains that the beginning of the theory and practice of manual and industrial education and particularly to its inclusion within schools can be traced back and found in the Renaissance. Further he suggests that the planning and implementation of manual and industrial education into schools falls into three distinctive stages. The first involved the theorising of systematic education in

agriculture, carpentry and other forms of manual industry as a feature of ideal and utopian states. This is discussed within the philosophical works of More, Rabelais, Bacon and Campanella. The second stage is marked by the articulation by progressive thinkers of courses and institutions that would provide a combination of industrial as well as general education. The third stage occurs when the theorising of educational thinkers and reformers such as Comenius bears fruit and gets implemented within the schools run by Franke, Semler and Hecker as manual and industrial education. It is suggested here that this three stage schema could be extended further through the addition of a further (fourth) stage. Such a stage would involve the implementation of highly developed and well articulated systems of industrial education such as the Russian system of instruction. Three contextualised vignettes appear below. The first example comes from the second stage described by Anderson where progressive thinkers are advocating combinations of manual and general education though Barlow (1990:8) makes the point that it takes until the 1880s before this combination is taken up and tried seriously in schools.

Vignette 1: The treatise by Moxon (1677 & 1683) in context

In England in 1562 the whole gild system of trade training and protection was overhauled when the Statute of Artificers was made law and apprenticeship expanded from a local system to become national. In Germany, the invention of the printing press was helping Luther to proclaim the reformation. With regard to education, Luther argued that “we must send the boys to school one or two hours a day, and have them learn a trade at home the rest of the time”. For Luther attending school for general education in literacy and numeracy needed to occur alongside the learning of a trade. Luther promoted the work ethic – for him, to work diligently was to serve god.

As humanism spread, this period began to breathe new life into teaching methods. The two fundamental ideas upon which instruction in the manual arts has been built emerged at this time. First, sense impressions, (or materialism), was considered ‘the basis of thought and consequently of knowledge’. From this idea grew the object method of teaching and later of the laboratory method. Second, is the related idea of ‘learning by doing’. From this came the recognition of the value of working through a process, of making something skilfully, and that this process was the basis of (developing) rational thought, (Bennett 1926: 30). Eventually this led to the placement of handicraft in schools and children being taken into workshops and into the fields to learn. In addition, Mulcaster, an English head master at this time added drawing to the school curriculum. He believed that ‘the hand’, ‘the ear’, and ‘the eye’ held the key to learning.

At the beginning of the seventeenth century, at a time when Shakespeare was writing in Elizabethan England, the Poor law (1601) was passed. This meant that church wardens could oversee pauper children as apprentices. The learning of a trade was very popular at this time as it provided a means for people from low socio-economic backgrounds to earn a living and to become law abiding citizens. At this time learning a trade also meant getting more general instruction in reading, writing and arithmetic. Francis Bacon espoused his philosophy of realism and advocated going directly to nature and using one’s senses to study the natural world. This was to

become the basis of learning applied sciences. Bacon was also amongst the first to use the term ‘manual arts’.

Comenius, a German teacher and priest, was to become one of the greatest educational writers of the seventeenth century. He has been called the father of modern pedagogy because some of his ideas were still in vogue centuries after first being formulated. Comenius wanted children to learn through their senses and whenever possible through nature, or realia. He argued that education should be developmental and concentrate first on the senses, then the memory and the intellect, then it should develop critical faculty. He followed Luther in arguing that education should be available to everyone. He added that it needs to be enjoyable for the learners and he suggested four different age and development appropriate types of schools. He wanted infant schools up to the age of six established in homes; he wanted a public elementary school in each village for students from 6 to 12 years of age. He suggested that there be a gymnasium or secondary school in each province for students up to 18 years of age and a university in each large province for students from 18 to 24 to attend. Amongst Comenius’ other works are his ‘methods of the arts’ written around 1638. In this he sets out some principles for teaching manual and industrial education.

The work of Comenius was advocated in England by social reformers like Hartlib and Petty. Hartlib took up the mantle in England and encouraged the poet Milton to write his treatise *‘Of education’*. Hartlib planned the establishment of a school of agriculture and husbandry that would utilise, develop, and further knowledge in these fields. He suggested that students would learn using a form of apprenticeship. His good friend, Petty, wanted to educate the poor in order to provide them with a means for a living. Amongst his other projects in 1647, he wanted to publish a great encyclopaedia of the arts and sciences that documented all the known facts of real and experimental learning. These men and their circle of acquaintances valued learning and new knowledge to the extent that they would go on to form the Royal Society of London, or as its full title when formed in 1660 under Charles II, The Royal Society of London for the Improvement of Natural Knowledge.

Petty proposed a college, or society, or guild of workmen representing different trades for the double purpose of producing fine examples of craftsmanship and to use these examples for the advancement of the mechanical arts and manufacturing. He proposed to compile a book that detailed ‘the mysteries of the trades’. This he suggested would describe in detail the manual processes associated with every trade. This task was taken up by his friend, Joseph Moxon though it was also a task that Diderot, would undertake in France nearly a century later when the first volume of the encyclopaedia was published in 1751.

In 1677, Joseph Moxon, also a member of the Royal Society, and hydrographer to the king published a series of articles on the most common and useful arts. The first fourteen of these articles were brought together in 1683 as one publication called ‘Mechanick Exercises or Doctrine of Handy Works’. This was a treatise on mechanical processes, tools, machines, projects and artefacts. Part 1 was called ‘Of Smithing in General’, Part 2 was on ‘Hinges, Locks, Keys, Screws, and Nuts (small and great)’, Part 3 ‘The Making of Jacks, and Bullet Molds, the Twisting of Iron, the Case Hardening it, with the Use of some Tools and Treated as before: also of the

Several Sorts of Steel, the Manner of Softening, Hardening and Tempering them'; Parts 4, 5 & 6 was on the 'The Art of Joinery' (spelt joynery by Moxon), Parts 7, 8 & 9 were on 'The Art of House-Carpentry'; Parts 10 to 14 were on 'The Art of Turning'. Bennett (1926:60) makes the point that a great number of the lathe tools described in this publication were still being used by turners at the time that Bennett was writing in 1926, some two hundred and fifty years later.

Vignette 2: The *Encyclopedie* by Diderot (1751) in context

In 1694, August Hermann Franke, a Professor in Halle Germany, was interested in improving the opportunities for the poor children and so for him the most important part of his institute was the orphanage. Alongside the religious instruction, he gave practical instruction in several manual arts. He observed that when left to their own devices the young students would busy themselves at building and working. He argued that the teacher could use this natural inclination to their advantage and use it as the basis for learning. These orphans were taught to spin, sew and knit. While this work and learning had an economic advantage, it was primarily for the students' development.

Other teachers working with Franke realised that a new and different style of secondary school was required for these students. Hecker who had taught alongside Franke, moved to Berlin where he set up a school to concentrate on the students learning important knowledge for use in their lives after school. This was the first non-classical secondary school curriculum in Germany and thus was formed 'the realschule'. The school run by Hecker emphasised science, art, and the trades and industries, and it put mathematics, mechanics, natural science and handicrafts into the curriculum.

The first wave of the Industrial Revolution was underway in England; and the work of Rousseau was very influential across Europe upon educational thinking especially through his novel *Emile*, published in 1762. Rousseau believed in a three pronged approach, with education occurring through circumstances, the study of nature, and through the manual arts. In his novel, *Emile* is advised to learn a trade not just in order to earn his living but because it was considered a vital part of the process of his education. Rousseau believed that the manual arts were a means of mental training. Bennett (1926: 81) suggests that while this marked a new era in education. However like many of the educational philosophers before him, Rousseau was advocating for an approach to education that he had planned and theorised, not that had actually been implemented.

In 1771, as Captain Cook arrived back in England after having claimed the great southern land for his empire, Pestalozzi was implementing his Industrial school at Neuhof in Switzerland. Pestalozzi was a young radical who during his university days felt the need to defend the writings of Rousseau when the magistrates had denounced it. Pestalozzi argued that the real reason for the material poverty of the people is their 'intellectual and moral degradation'. What poor people really required he claimed was education.

Pestalozzi married, turned to farming and purchased a property he called Neuhof, meaning 'New Farm'. His experiments with the education of his own son gave him

experience and ideas to develop further. In 1774 he brought around twenty poor children into his own home. He combined an active lifestyle of working on the farm, with the learning of school work. He engaged students in conversations about their interests and from these discussions developed informal programs. It is claimed by some educational theorists that he introduced psychology into his teaching as he developed specific methods of teaching. From a broad educational viewpoint the farming school experience was a total success and very fruitful, yet from an economic viewpoint the farm and industrial school were not viable and therefore economic failures. Others saw what Pestalozzi was attempting and while this was not profitable as a business provided him with funds to stay afloat and to take in more poor children to educate.

It is in this context that '*the Encyclopedie*' was developed. Some like Gillespie (1993) claim that Diderot's *Encyclopedie* brought dignity to the arts and the trades. 'The different trades and industries were investigated and classified according to the principles revealed in the investigation', (Gillespie 1993: XX), and it is further claimed that the act of analysis elevated the trade from folklore to science, (Gillespie 1993: XX). Interestingly, this is not necessarily how working people saw his project. Diderot claimed that trades people were sometimes less than forthcoming about their work. Their reluctance was further compounded as many trades had their own terminology and some even their own lexicon. Yet it is not in the descriptions that the *Encyclopedie* is most powerful it is the combination of the explanations together with the collection of the many plates or drawings. Many of the original drawings for the *Encyclopedie* were completed for Diderot by the draughtsman Louis-Jacques Goussier. The first volume of illustrations appeared in 1762. Initially a plagiarism charge came from the Academie des Sciences but then fell quite. What can be said is that the claim by Diderot that he visited hundreds of workplaces to interview tradesmen so as to document their work, is generally regarded to be a fabrication, (Blom 2004: 255).

Vignette 3: The Russian system of instruction in context

In 1868, Victor Della Vos and his associates devised the Russian system of workshop instruction for use at the Imperial Technical School in Moscow. This Technical school grew out of the need to train workers for the Railway workshops. Della Vos who was an engineer by profession prior to taking over the running of this important Technical school, was dissatisfied with the ad hoc way that training was developed and looked for a more logical approach. He went on to devise training methods and programs based on a thorough and systematic 'analysis of all the tool processes and construction methods in the mechanical arts'. This systematic analysis was broken down into its various elements and the elements and their sequencing became the basis of the training. Further, it was found that 'when the idea of analysing and breaking down of the manual arts into their elements and of arranging these elements in pedagogical order was shown to be possible and practicable, it was recognised that these arts could be taught in schools by essentially the same teaching methods as the other school subjects' (Bennett 1937: 13). This shifted the method of learning of manual and industrial education from imitation and immersion through apprenticeship to a method of mastering the elements of the trade. It was also found that the mastering of the elements could be undertaken in a school or institutional setting, not only through an apprenticeship arrangement.

In 1868, Victor Della Vos, modernised and re-organised the School of Trades and Industries in Moscow. Workshops known as construction shops participated in authentic work by employing skilled workers to take on and produce private orders. Alongside the construction shops were built instruction shops. Here the worker/learners were to learn the fundamentals of the mechanical arts, in the least possible time, in the largest class sizes possible, by a sound systematic method, and in a way that allowed the teacher to be able to track the individual progress of each student (Bennett 1937). Under this system it took up to six years to thoroughly train civil and mechanical engineers, draftsman, foreman and chemists. The trades were learnt in a much shorter time.

Della Vos developed eight principles which underpinned this system. These originally appeared in about 1876 but later revisions culminated in these as cited below and are dated from Della Vos in approx 1893. This revised list of principles is listed in Bennett (1937: 17 & 18):

1. Each art or distinct type of work has its own separate instruction shop; e.g., joinery, wood turning, blacksmithing, locksmithing, etc.
2. Each shop is equipped with as many working places and sets of tools as there are pupils to receive instruction at one time.
3. The courses of models are arranged according to the increasing difficulty of the exercises involved, and must be given to the pupils in strict succession as arranged.
4. All models are from drawings. Copies of each drawing are supplied in sufficient number to provide one for each member of a class. The drawings are mounted on cardboard (or, for the blacksmith shop, on wooden boards) and varnished.
5. The drawings are made by pupils in the class for elementary drawing, under the direction of the teacher of drawing with whom the manager of their shops comes to gain agreement concerning the various details.
6. No pupil is allowed to begin a new model until he has acceptably completed the previous model in the course. He must receive at least a grade of three, which is considered good.
7. First exercises will be accepted if dimensions are no more than approximately correct; later exercises should be exactly to dimensions; therefore, the same marks given to a student at different periods during his course do not express the absolute, but the relative, qualities of his different pieces of work.
8. Every teacher must have more knowledge of his speciality than is necessary merely to perform the exercises in the course of instruction. He must keep constantly in practice so that his work may be an example of perfection to his pupils. Such dexterity increases the authority of the teacher.

The teaching of the course was divided into three successive periods. In the first period, pupils were given the name of the tools, shown how to care for them and use them. They were instructed on various materials and their properties – theory and the use of tools, techniques, materials and processes. In the second period the pupils would use the tools and processes learnt to manufacture a joint in woodwork. Instruction in metalwork followed a similar plan – always proceeding from simple forms to the more complex. During this period the student was observed by the

teacher and corrected or adjustments suggested as required – guided use of tools techniques, materials and processes to make joints. In the third period, the pupils would make whole or part of various mechanisms and through these acquired an understanding and practical knowledge of working in wood and metals. During this period the teacher guided whenever necessary but the observation of the teacher was weakened so that the student would be encouraged to develop independent – application of tools, materials, processes within the production of elements and components.

The Russian system of training was showcased at various Trade fairs across the globe, at St Petersburg in 1870, Vienna in 1873 and Philadelphia in 1876. This exposure ensured that it was picked up by others and exported into use outside of Russia, across Europe and the USA. Runkle opened the first school based on the Moscow Imperial Technical School in Komotau Bohemia in 1874. In 1878 the Moscow school was exhibited at the International Trade Fair in Chicago alongside some of the new schools that had come into being as a result of previous exhibition of the Russian system.

Discussion

Questions about who is documenting the work of the manual trades and occupations and for what purpose are central to this paper. A further and related issue arises about the complex role of literacy as a tool and practice for documenting the working knowledge of the tradespeople by others, often who were middle class, and outsiders to the work. These questions offer another take on the divide between those who work with their hands and those who work with their heads and the relationship between them. Or as Anderson begins his book, ‘From the dawn of time there have been two different kinds of education – the education of the manual laborer through practice with tools, implements, and machines in shop, field, ship or mine, and the education of the brain-workers and members of the leisure class in the school, largely with the aid of books’ (1926:v). It needs to be asked then, who were the intended audience and readers for the texts that were produced in documenting the trades, and how were these understandings going to be used?

The formation of the Royal Society of London ushered in a period of great scientific discovery in England of which industrial and manual education was a significant component. One of its members, Joseph Moxon wrote his ‘Mechanick Exercises or Doctrine of Handy Works’ (1677 & 1683) in an effort to document the tools and practices of the trades at that time. Through the use of multimodal texts which illustrate and describe the work of a number of trades, his treatise is attempting to achieve numerous objectives. In the first instance he is attempting to acknowledge the knowledge base of tradespeople. He appears to be wanting to promote the trades as legitimate and worthy occupations. While satisfying these objectives his treatise also makes this knowledge available to others who can read and understand it and thereby disseminates the workings of the trade more broadly.

In France during the time that the Encyclopedie was written (1751 – 1780) Diderot and the other authors of the encyclopedie were under no elusions that they were involved in a subversive project that confronted the power of the church and monarch alike. These authors were attempting to document, promote and democratise secular

knowledge. It is these multimodal texts which stand as records of industry and life at this time. Pennabecker (1998), cited in Hansen (2009:17), states that the Diderot *Encyclopedie ou Dictionnaire raisonne des sciences des arts, et des metiers*, as a thirty five volume compendium is considered the centrepiece of the Age of the Enlightenment. In a slight aside, contemporary reading and study of the text and plates have led some analysts to state that they think that some trades such as cabinetmaking may have gone backward since they were documented. Yet it must be acknowledged that it is because of the existence of the Encyclopedie that such judgements can now be made.

There are three main features of the Russian system which are considered innovative. First is the use of a dedicated instruction shop standing alongside Construction shops that were doing actual live work. The close proximity of the authentic work may have provided scaffolding to learners who could then see and understand the role of various components which they were required to manufacture. Importantly because the instruction shop was located separately from the construction shop it wasn't long before questions were asked on how necessary was it that they be co-located. This led to experiments of having instruction shops without the construction shops. In effect, the instruction shops when separated became stand alone educational or learning facilities. In this way, the instruction shops became the basis of a training institution separated from the worksite.

The second innovation here is with the organisation of the instruction. The seeds of the contemporary four-staged pedagogy for workplace learning such as cognitive apprenticeship which is discussed by Billett (2001). Cognitive apprenticeship consists of modelling, coaching, scaffolding and fading. Although, Hansman (2001) citing, LeGrand Brandt, Farmer and Buckmaster, (1993); describe this in terms of five stages, which they describe as modelling, approximating, fading, self-directed learning and generalising. The strategy is that the guidance of a more expert worker assists in making opaque knowledge more accessible. Guidance and instructional interventions by more expert others includes providing descriptions, analogies and through the use of diagrams. Thereby bringing this to the attention of the learner and making known what might otherwise have remained hidden from the learner.

The third innovation was the following of a course of exercises that had been developed for learning the work and which were derived from a scientific analysis of the manufacturing processes. In this way Maclean & Wilson (2009) speculate that Della Vos 'may be designated as the originator of the task analysis method for the sequentialisation of working knowledge in vocational didactics, which eventually became the basis for competency based TVET' (pg xci). This approach to VET curriculum has been described by some as encompassing an Engineer's logic. Hanf (2002:15), is also cited by Maclean and Wilson (2009), when he states that 'several hundred courses across Europe evidently adhere to the principles expounded; (2009:xcii), now some 140 years later than when originally stated by Della Vos in 1868.

Conclusion

'History has been defined as the extension of the past into the future' (Maclean & Wilson 2009: xcv) and hence while over eighty years old, study of the historical

works of Anderson and Bennett are beneficial to those interested in the origins of debates in contemporary Australian VET. Similarly a review of the three approaches to documenting the trades and industry are a worthwhile and rewarding experience. Moxon's treatise shows tools of trade that are familiar even today. The Encyclopedie consists of illustrated texts that amongst other things describe and explain the work of the trades and various aspects of industry at that time. This publication holds particular historical significance to those who work in vocational education and training. Similarly, the Russian approach to systematic instruction as developed by Victor Della Vos in Moscow too is highly important to those who study the curriculum and pedagogies of vocational education and training. Like the Russian system, all VET programs across Australia are derived from an analysis of the work and arranged in some form of developmental pathway. It is suggested that the training at this school is a close precedent of current methods of vocational education and training in Australia and in particular is one of the ancestors of competency-based training. The curriculum movement from simple to complex, from parts to whole, and sequentialisation all based on task analysis of the job roles was very prominent in the model of competency based training implemented in some Australian VET institutions in the 1980s and 90s. Finally, questions will always be raised about the effectiveness of training approaches that rely upon accurate depiction of the social practices that make up trades and occupations through textual abstraction.

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