

Designing a dental curriculum for the twenty-first century

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IN BRIEF

- Describes the rationale for the content of a new twenty-first century curriculum.
- Relates the content of the curriculum to how it is delivered in line with accepted educational theory.
- Accepts that knowledge, skills and attitudes are learnt in different ways but are best learnt in context in an integrated, spiralling curriculum.

A healthcare curriculum must be up-to-date, fit for purpose and relevant to the population it serves wherever that population might be, worldwide. In this paper we describe the rationale for the design and implementation of a curriculum in a new dental school in UK. We assessed the general and dental health needs of our local population and proposed a set of core skills our dentists will need on graduation and in the future. This core learning falls into three domains of learning. The psychomotor domain covers the learning of technical skills for which we use the shorthand 'hands'. The affective domain covers empathy and behaviour management, that is the 'heart'; and the cognitive domain including critical thinking, the 'head'. The three domains require different ways of learning but all are delivered in context in an integrated, case-based spiralling curriculum building in complexity year on year. Students treat patients from half way through year 1, which helps them appreciate the relevance of the 'hands', 'heart' and 'head' of dentistry as they begin to build their knowledge and experience.

INTRODUCTION

The modern concept of a curriculum, originally derived from the Latin word for a race course, was first described in depth in a book by J. F. Bobbitt in the early twentieth century.¹ His ideas were modern in that he described the curriculum as a series of learning experiences to which a child ought to be exposed on the journey, or course, to adulthood. It encompassed taught school lessons as well as school ethos, plus societal pressures and *mores*. He understood the power of what is now known as the 'hidden curriculum'^{2,3} and importantly, what society needed in its adult population. In other words a curriculum should be fit for purpose. He realised that curricula were values driven and built upon the designer's beliefs about what a successful student should know, and how they should best get to know these things.

What is crucial, then and now a hundred years later, is that those designer's values are up-to-date, relevant to need, and fit the prevailing circumstances. It is also desirable, in a health care profession curriculum, that the values underpinning the syllabus should be similar to, or symbiotic with, the values underpinning the health services in which the students are to practise after graduation,⁴ wherever that may be worldwide.

A curriculum, in its fullest sense, has four elements: the teaching and learning strategy; the content; assessment procedures; and evaluation processes.⁵ An earlier paper⁶ described the first of these in Peninsula Dental School; the 'how' elements of curriculum design. This current paper focuses on the content of the curriculum; that is the 'what' and how it was determined. It describes the two main drivers of content shaping the curriculum: firstly, the health needs of the population the graduating dentist will serve in the first half of the twenty-first century and secondly, the corollary of those needs; the knowledge, skills and attitudes required of the first class dentist treating those patients. Some of these characteristics are immutable or innate, on which it is possible to base the selection process for entry

into the curriculum. Following from this, the curriculum must incorporate the learning of all the identified desirable, mutable ('learnable') characteristics of a dentist. This requirement determined both the teaching and learning strategies⁶ and the balance of the curriculum content. It is almost impossible to have an explicit formal curriculum without an implicit 'hidden curriculum', which is defined by the messages the teaching processes and assessment experiences send to students.^{2,3,7,8} The trick is to ensure that the two are aligned and work together pulling in the same direction. The 'hidden curriculum' is conveyed as much by 'how' we teach and assess as 'what' we teach and assess. Finally, this paper describes how the desired content is implemented into the curriculum.

DEFINING CURRICULUM CONTENT

Population needs

As Bobbitt¹ had urged, our curriculum had to be fit for purpose and therefore we approached defining what students really need to know by considering the epidemiology of disease (including dental disease), demographic shifts in an ageing population, and the demographic traits of our local region in UK. Patients in future

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will have different needs from those of today, both in their general and dental health needs.

Figure 1 is a diagrammatic representation of the dental health needs of the population of the UK approximately 30 years ago. What it attempts to convey is that the majority of the population had dental health problems which were 'middling' in their complexity. That is, most people had quite a number of teeth with large cavities which entered and remained within the 'restorative cycle' unless they have subsequently been extracted and replaced by dentures. Similarly, periodontal disease was common, frequently fairly severe, and often resulted in tooth loss. In Figure 1 at either side of this 'middling group' on the continuum are two groups of people. A small but important group of people, (represented at the right hand side) had extremely complicated oral health needs, requiring complex restorative techniques. A few (represented by the left hand side) had almost no dental needs in that they enjoyed good oral health being the lucky exceptions who had not suffered dental decay or periodontal disease. Such people were uncommon in 1978.⁹

Figure 2 represents the effect of improved oral health and hygiene, changing patient expectations and shifting demographics on the complexity of dental treatment need existing in the population. We posit that this diagram is representative of how the situation will be in approximately 2015. Due to the advent of fluoride toothpaste, along with heightened awareness of the importance of diet and hygiene on oral health, in 2015 many of the population will be caries free or nearly so. Many mouths will be clean. Periodontal disease will be less frequent and milder in form when compared to disease rates in 1978. Very few people will have 'middling' amounts of disease, with several sizeable cavities and some periodontal disease. Most will have none or very few cavities, or have well restored mouths which are generally healthy. However, the right hand side of the diagram indicates that by 2015, those who were middle aged in 1978, with heavily restored mouths, will have become elderly. Unlike in previous generations, the teeth are likely to be retained, albeit in a compromised state of advanced restoration, due to the restorative cycle the teeth have been involved in for the previous 40

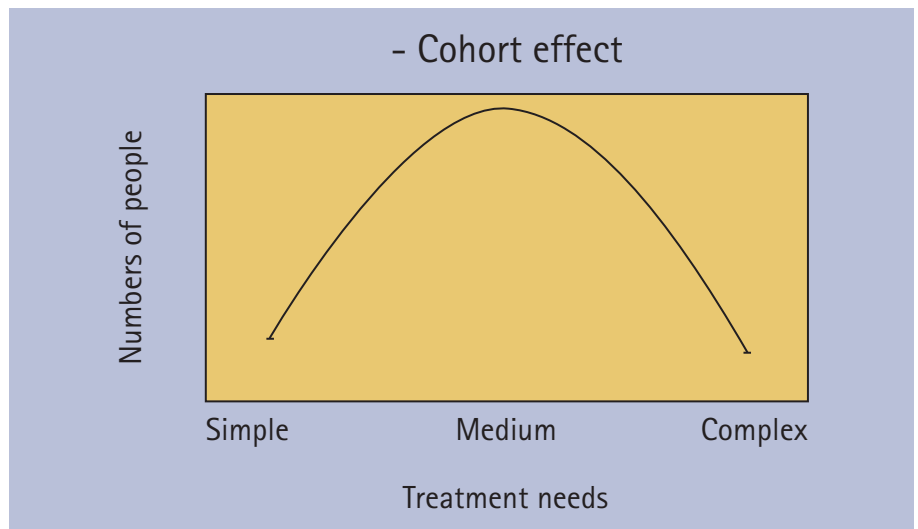


Fig. 1 Diagrammatic representation of the distribution of dental disease complexity circa 1978

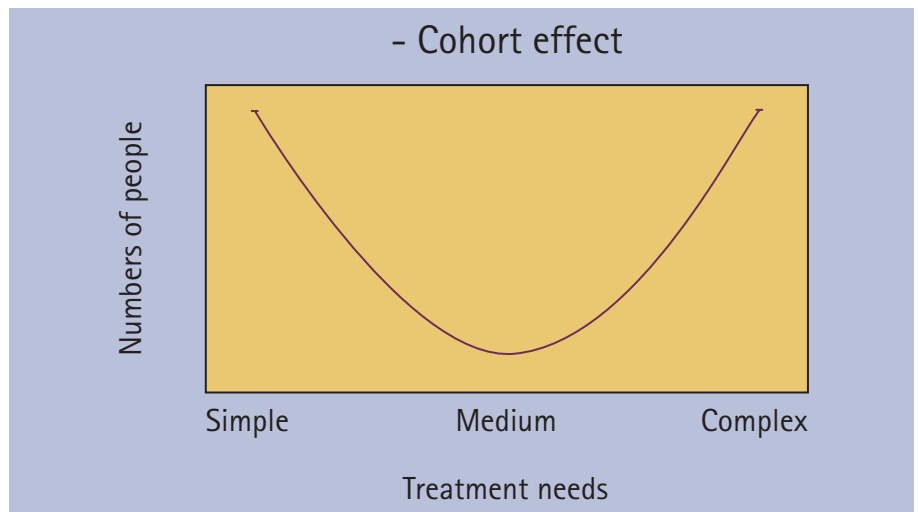


Fig. 2 Diagrammatic representation of the distribution of dental treatment need complexity circa 2015

years. Previously a large proportion of persons of this age would be edentulous.⁹ This diagram is important, as we face an ever growing number of very elderly people with complex oral health needs. Dentistry has never before faced the prospect of a large cohort, (much larger than previously due to the post war birth bulges) of people who are likely to live into extreme old age and also be dentate. Unlike in Figure 2, there are few people with the need for mid-complexity dentistry, but there are a great number of individuals whose dental health needs are zero, or almost zero. This represents the younger, healthy generation, with good oral hygiene, few cavities but very high expectations of their dentition, both in terms of longevity and aesthetics. Of course, this is a generalised picture: social deprivation and immigration from

overseas will mean that there is likely to be a population with poor oral health due to barriers to care such as lack of access or language difficulties.

IMPLICATIONS OF POPULATION HEALTH NEEDS ON DENTAL CURRICULA

By studying the changing dental epidemiology Peninsula Dental School seeks not to fall into the trap of designing a 'sabre-toothed curriculum'¹⁰ - one designed for a situation which will be extinct by the time the students graduate, or have been in practice for a short time. Changes in the nature and distribution of dental disease and altering patient expectation would suggest that in 2015 and beyond, for those with healthy mouths, dentists will need to be highly skilled and committed to

health protection, health promotion, health enhancement and prevention of disease in both individuals and the population. This will ensure that the large number of people with good oral health stay healthy, and the dentist of the future will need to play an important part in community-wide health maintenance programmes.

In contrast, there will be a large ageing population with substantial restorative needs and complex oral health problems. In addition, these people are likely to include the very elderly, the disabled, those living in isolation, those with physical or mental health problems and some with multiple combinations of these conditions. As the population ages, there will be an increase in people suffering from a number of chronic illnesses, and the numbers of patients with very complex needs will be considerable. This poses a very serious set of challenges for the dental health profession.

This analysis therefore suggests that a dental graduate who will be capable of providing relevant and needed oral health care must have the following skill sets:

- effective prevention, oral health promotion, health enhancement and health protection skills
- extremely high levels of communication skills, understanding of social environments and communities, psychological knowledge
- immense restorative technical skills, ability to deal with implants, fixed prostheses and the effects of reduced manual dexterity/oral hygiene on patients' ability to maintain such interventions
- ability to communicate with those who may find the world confusing and unaccommodating
- profound knowledge of medicine, pharmacy, medical emergencies and drug interactions.

This list and the curriculum content it informs must be updated over time in order to ensure that, in the future, the curriculum continues to cater for the learning needs of the next generation of dentists, who will face a different set of, as yet unknown, challenges.

Reflecting on the skill sets, it is clear that they fall into three distinct categories (Table 1) which map onto Bloom's three domains of learning.¹¹⁻¹³ Firstly, students need the

Domain	Type of skill	Shorthand
Psychomotor	Technical skill and clinical knowledge; competence at procedures	'Hands' (do)
Affective	Understand, motivate and empathise with patients	'Heart' (feel)
Cognitive	Critical, clinical reasoning; rational decision making; knowledge of facts	'Head' (think)

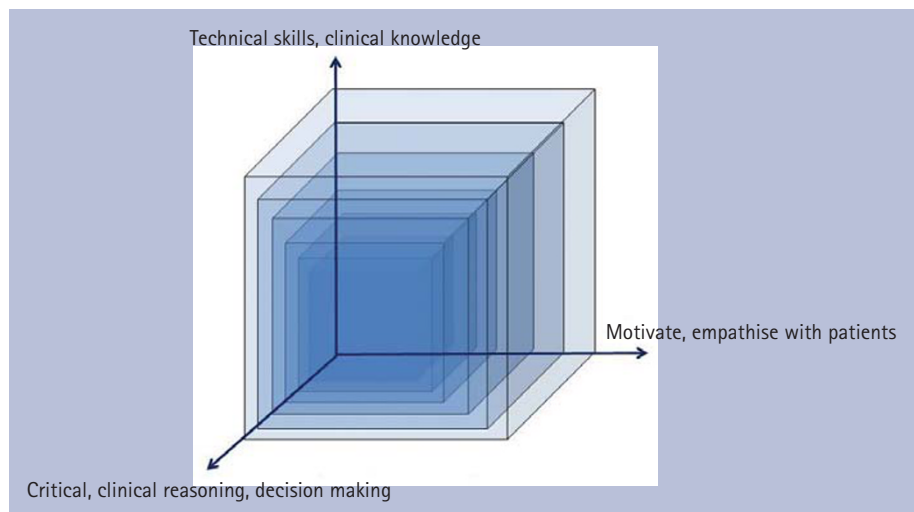


Fig. 3 Diagrammatic representation of the growth of the three domains of learning through the curriculum

technical skill and clinical knowledge in order to undertake complex procedures in the mouth. Secondly, they need behaviour management skills in order to empathise, understand and relate to the social context of disease and illness; and thirdly, critical path analysis, reasoning and decision making skills. This dimension of their learning provides the ability to synthesise research evidence, patient preferences, their own personal experience and ability in order to plan treatment. Bloom's classification is particularly apposite for the learning of a subject like dentistry, which requires the understanding and solving of a person's problems by practical means. He refers to the 'mastery' of a subject,¹¹ rather than simply the accumulation of facts, which is consistent with the learning of a vocational profession over time.

These core skills are learnt in different ways. For example, the ability to undertake clinical procedures in the mouth effectively and efficiently requires behavioural skills of manual dexterity and precision. Development of these psychomotor skills requires the learning of sets of motions and movements which are defined and refined by practice and repetition.¹³ These are 'doing'

skills for which we use the shorthand 'hands'. In contrast we use 'heart' to describe the ability to understand and relate to patients in the context of their own lives which belongs in the domain of understanding emotions and attitudes. Such abilities require development in the affective domain of learning. Lastly, knowledge of the evidence and facts, knowledge of the patient and self-audit are all rationally conceived and therefore belong to the cognitive skills a dentist needs. This ability to reason on the basis of knowledge is a cognitive process, a thinking process for which we have used the shorthand 'head'.

IMPLEMENTING CURRICULUM DESIGN

The concept of dimensions has helped in the development of a coherent curriculum which offers ever more complex learning experiences throughout the programme, as is portrayed in Figure 3. Students' growth in the three dimensions is a gradual, continuous process with layers of learning experiences building one upon another. Each time a student revisits a topic s/he identifies prior knowledge and adds complexity with new concepts, knowledge or skill in an iterative process. This is a

true spiral curriculum as first advocated in 1960 by the educational psychologist, Jerome Bruner,¹⁴ and now taken up in medical education^{5,15} and other disciplines.^{16,17} At Peninsula, each dimension starts with the basics, for example in the 'hands' dimension, students learn practical cross infection control at the beginning of year 1, represented by the inner corner of all the boxes. The 'hands' skill is expanded throughout the programme until the end of year 4 (the outer box) when they are able to carry out complex restorative work.

If these domains of learning are accepted as the foundations of developing highly skilled dental practitioners, then the curriculum must be designed to build the student's ability not only gradually, but in an interrelated way. The dental problems of a patient do not exist in isolation. Therefore, it is inadvisable to break the learning outcomes down into 'subjects', as this militates against a holistic approach to patient care, and is anything but realistic. The evidence strongly suggests that learning in a realistic context, which by its nature is integrated, is most effective for promoting deep and usable knowledge and skills.¹⁸⁻²¹ These ideas of contextualised learning are being implemented in dental education around the world.²²⁻²⁷

At Peninsula Dental School this is achieved by taking a life-cycle approach. Students study case scenarios in which an aspect of each domain is studied. All aspects of learning are in the context of the case including the learning of technical skills: 'head', 'hands' and 'heart' working together. Early exposure to patients in the clinic, from halfway through year 1, gives plenty of opportunity to develop the affective dimension ('heart') from real life in addition to the paper based cases. In each year of study the case scenarios increase in complexity. In this way the student travels from an ability to recognise, understand and deal with normality at each stage of a person's life, through to an ability to recognise and manage moderately complex cases to an ability to understand and deal with the most technically complex, socially challenging cases which require immense treatment planning and decision making ability.

To give an example of how this design of curriculum works, in week 2 or 3 of the programme the case scenarios might

involve an infant. In the first year, in this first 'visit' to an infant, the hypothetical child is healthy, from a non deprived and non complex background and would have no pathology. In other words the student studies normality. The student engages in learning about normal child development, the anatomy of the developing skull and the anatomy and neuroanatomy of the developing dentition. They might also learn about nutrition, breastfeeding, and innate and acquired immunity. They would learn the behavioural and physical skills of dentally examining an infant. Thus, cognitive learning of facts is contextualised in the patient scenario driven by the 'need to know' and linked to sets of behavioural skills. Learning is driven by and focuses on the needs of the patient and the dimensions are seamlessly linked through this holistic approach. Patient centred learning therefore becomes driven by the student's sense of vocation rather than by the need to regurgitate sets of information.

In the second year, early in the programme the student would again study an infant. But this time the case study which is used to drive a three week block of teaching and learning, would have a small amount of disease (decay), perhaps an aberration from normal development (a cleft lip), a slightly less 'normal' family background (poverty). For such a case, the student might learn about abnormal development and the effect of maternal and child nutrition on growth and development. They might learn the behavioural and physical skills of taking an impression of an infant's mouth. Once again the acquisition of factual scientific information is driven by the student's will to be able to help patients and is more readily retained because the factual information is presented in context. Similarly, in year 3, the Life Cycle from infancy to old age is followed, but in this year of study, the cases have middling to complex dental/oral needs (child might have a severe hypodontia associated with ectodermal dysplasia). They would be presented as having difficult social, emotional and psychological environments, and as very resistant to health messages, in compliant with advice and medication, and difficult to treat. Thus, the student by year 4 has been presented with contextualised

information about all aspects of patients which they might encounter. This spiral 'ramping up' of the difficulty and complexity of the Peninsula learning objectives occurs in all of the three dimensions of clinical and technical skill; behaviour management skills; and critical thinking and decision making; ie the 'hands' 'heart' and 'head' of dentistry.

CONCLUSION

A dental curriculum is a journey which takes its students from where they are, to where they need to be. Where they need to be is in a position to deliver the dental care required by the population and by their advocates, in this case, the NHS. This can be achieved by having selection criteria to select on the immutable attributes which a successful dentist must have, and a curriculum which develops the other more mutable attributes needed by a dental practitioner. The attributes required can only be determined through analysis of the past, current, and future health needs, and via knowledge of the different domains of learning, and how these relate to dentistry and to relevant learning activities. The spiralling curriculum, which increases the depth of student learning at each 'visit' to a topic, allows students to build layers of knowledge, skills and attitudes in a logical manner. On graduation they will be well prepared for their journey towards the 'mastery' of their profession.

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