Chapter 2.1

CURRICULUM STRUCTURE: PRINCIPLES AND STRATEGY


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Abstract

This report provides general guidelines for the structure of a curriculum, followed by specific advice on the principles of learning and teaching, the process of restructuring and change leadership and management. It provides examples of several educational philosophies, including vertical and horizontal integration. It discusses the use of competence, learning outcomes, level of degree and assessment and provides a number of recommendations. It does not seek to be prescriptive of time allocation to disciplines within a curriculum. Although this report has been written primarily for those who will develop an undergraduate curriculum, the information may be sufficiently generic to apply to the recent development in graduate entry (‘shortened dental’ or ‘accelerated’) courses and to postgraduate degree planning and higher education certificate or diploma courses for other dental care professionals (auxiliaries). The report was developed by a working group of ADEE and inevitably has a European bias as progress is made to converge and enhance educational standards in 29 countries with different educational approaches – a microcosm of global collaboration.

Introduction

Curriculum structure is an element of the core business of every dental school. Achieving the correct structure requires an investment in time, energy and expertise. This investment is important to maximise the educational experience for each student and to produce dentists who are able to practice effectively, efficiently and with compassion in a world that is experiencing ever more rapid changes in knowledge, technology and cultural mores. Establishing the curriculum is the first stage in a sustained process of evaluation and development which is essential to ensure that it remains fit for purpose. This report gathers together information from a range of disparate sources and presents a specifically dental approach to curriculum structure and development.

Theory and Principles of Curriculum Design

Principles of Learning and Teaching

A curriculum has been defined as ‘a planned learning experience’ (1). Whilst the aim of education and training is to enable students to learn, teaching has to be considered as a series of activities that stimulate, facilitate and progressively guide the learning process, culminating in a graduate who has the skills to engage in lifelong, self-directed, reflective learning. All teaching activities should serve to enhance the learning and development of the student, i.e. they should be student centred. The principles have been described in several textbooks on learning and teaching (2, 3, 4), and have been refined and enumerated by Kersten (5):

1. Learning is an activity of the brain that principally acts to best effect during self-study.
2. Sufficient relevant prior knowledge is a prerequisite to learning; finding the entry level to new knowledge is important.
3. Students will learn more if the material is meaningful and relevant to them and their perceived role as a dentist, i.e. it is learning in context. (The corollary of this is that learning out of context is more challenging; for example the teaching

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and learning of medical subjects when taught by physicians and or surgeons may be an area of difficulty)

4. Students need to practise in order to learn and master knowledge and skills.
5. Favourable learning conditions contribute to learning.
6. Material presented in a logical order is easier to learn.

These principles should influence the structure of the curriculum and the teaching methods adopted. They represent the way a lecture or a workshop should be structured, the way a module should be shaped and finally how the different modules (units) should be arranged in a curriculum.

In this way structuring not only determines the sequence in which subjects are presented, but also determines the method of teaching that fits a subject best and how the time available should be devoted to the different activities students need to master. Since learning takes place principally during self-study, time for self-study is essential. Not only should there be sufficient time for self-study, but it must also be appreciated that the scheduling and guidance of self-study activities is important. Self-study must be followed by effective evaluation, otherwise excessive or poorly-directed self-study may lead to inadequate or inappropriate learning. From a Dutch study it appeared that the number of self-study hours decreased as contact hours increased (6). Contact hours are necessary to encourage students to learn as without interaction with teachers the average student will not study regularly. However, above a certain number of instructional hours per week (that depends on the subject), an increase in instruction time is counter-productive as the student may become over-stimulated or have ‘information fatigue’. Chambers, in a study on workload, came to comparable conclusions with respect to the relationship between number of hours of study and performance (7). The greater the workload the more likely it is that students tend towards superficial learning. A workload that is correctly balanced and focused towards the post-qualification ‘world of work’ will benefit the student. It is commonly accepted that in the immediate post-qualification period the average student will spend his/her time learning more about what is required for the service he/she provides, including clinical, scientific or research activities. It follows that during undergraduate training students must be exposed to a range of activities, which must be properly evaluated or assessed.

A balance is necessary between the prescriptive elements of a curriculum and the desire to produce self-directed learners. These tensions have been represented diagrammatically by ten Cate:

**Creating Constructive Friction**

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<thead>
<tr>
<th>Student Self-Regulation</th>
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<td></td>
<td><strong>High</strong></td>
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<td><strong>High</strong></td>
<td>Destructive Friction</td>
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<td><strong>Medium</strong></td>
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<td><strong>Low</strong></td>
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Presented at 33rd ADEE meeting, Dublin 2007
Clearly, scheduling the time allocated during a year, a module and a week and even a day is an essential part of structuring. It also means that structuring a curriculum or a programme should not be driven principally by tradition or convenience, or by the preferences and wishes of individual teachers, or by the technocratic approach of managing a dental school. Unfortunately, the above may have a malign influence in the school, may be difficult to identify clearly, and can be a barrier to achievement of the intended educational aims and outcomes.

The rich variety of students on dental degree programmes brings diversity in the way that students learn. The curriculum should recognise this diversity and attempt to cater for all types of learner. Current literature is confusing in the use of the terms learning styles and approaches and the two terms have been used synonymously. There is a major difference between the two in that the learning style is relatively fixed and part of the personality of a learner, whereas the learning approach is varied according to circumstance. To try and alter a student’s style of learning may be highly disruptive to their learning (8).

A Learning Style has been defined as a ‘predisposition on the part of a student to adopt a particular learning strategy regardless of the specific demands of the learning task’ (9). Alternatively, it could be stated as ‘a description of the attitudes and behaviours which determine an individuals preferred way of learning’. This has been divided by Honey & Mumford (10) into 4 categories: 1. Activist; 2. Reflector; 3. Theorist; 4. Pragmatist. They describe the Activist as the student that responds best when they feel they are facing a new challenge and new experiences in their learning; the Reflector is described as the student that responds well when given time to consider and reflect on a new learning experience; the Theorist responds best when given clear aims and objectives to their studies; the Pragmatist responds well to learning when it is perceived as relevant to their practice, and they can foresee a practical application for their learning.

A Learning Approach is a ‘pattern of information processing activities used in specific situations to prepare for an anticipated test of knowledge and skills’ (9). Marton and Saljo (11) first described two learning approaches, deep and surface. A further approach, that of a strategic learner, has been added (12, 13). Deep learning is considered to be an ideal approach as the information is well understood and retained for prolonged periods of time. Surface learning is reflected in poor understanding and poor retention. Obviously, a curriculum that promotes deep learning is preferred.

Those responsible for curriculum development should be aware of the European Credit Transfer Scheme (ECTS). Within Europe it will have an impact upon the format and structure of their course. ECTS anticipates that students will accumulate 60 credits per year, and that 1 credit represents 24 – 28 hours of staff/student contact time, self-study and assessment. Credits should be based upon the achievement of certain learning outcomes. A credit system facilitates the transparency of the curriculum and student mobility which, in Europe, is supported through the Lifelong Learning /Erasmus (14).

At graduation students should be provided with a document that describes the context, nature, level and status of the studies pursued (for instance a Diploma Supplement in Europe). Such a document further promotes mobility for the individual and transparency of curricula and standards across countries (14).
It is important to remember that teachers also need pedagogic education in order to be able to implement changes. Schools should organise a variety of on-going training activities for teachers, e.g. short “survival guides” that inform staff of the proposed/imminent changes, and more advanced activities that involve teachers in their own pedagogic development.

**Guiding Principles**

European dentistry is moving forward in response to the challenge of the Bologna Process (15, 16). Taskforces commissioned by DentEd/ADEE have produced policy documents to guide the process of harmonisation of dental education (www.adee.org).

Fish and Coles (17) state that ‘... designers of ... curricula ... need first to study critically the practice for which their curriculum is a preparation, and then design a course which enables undergraduates to prepare for this’ (page 14). They add ‘A curriculum may be written or rewritten (i.e. designed) on paper, but it can only become a reality ... in practice (i.e. developed). But these processes are intertwined – they develop and refine each other. The initial design will, inevitably, precede the development, but the development will, inevitably, inform the re-design, and it will do so, ... through a principled and sound form of educational research called curriculum evaluation’ (pages 24, 25). Later they state, ‘Assessment is first and foremost an educational practice and part of a holistic educational process which includes teaching and learning’ (page 168).

From this it follows that a Curriculum is a complex, dynamic, and evolving entity, which needs constant attention. Curriculum designers should start by considering the knowledge, skills and attitudes that their graduate will need for contemporary and future dental practice, and how the achievement of these outcomes will be measured. Having established the end-point they should work backwards, deciding the strategies required for these learning outcomes to be best achieved whilst continuously evaluating the whole process in a structured manner making changes as appropriate.

To this should be added the concept of Complexity (see References 18 to 21 for a series of four articles published in the British Medical Journal, edited by Greenhalgh and Plsek in 2001), which confirms that professional practice is not a simple, unproblematic matter of common sense, nor is it where acquisition of knowledge and skills is achieved purely by repetition. They also emphasise that the relationship between items of knowledge may not be predicable or linear. Complexity continually challenges the practitioner to develop a cogent and flexible approach to problem solving at theoretical, practical and behavioural levels. The final article in the series (21) suggests that the curriculum should recognise this and be designed to render the new graduate not only competent, but also capable, i.e. the ‘extent to which individuals can adapt to change, generate new knowledge, and continue to improve their performance’. However, as indicated below, the definition of Competence by Chambers includes these elements.

Furthermore, the attainment of clinical wisdom (22) is a gradual process, which grows throughout a practicing lifetime and will be only partially achieved at graduation. Clinical wisdom means understanding the needs and desires of the patient, and brings these together in an appropriate manner to produce a treatment plan that will be deliverable from a clinical perspective, and which will address the concerns of the patient. It is a mental rather than a physical skill, which develops with experience and reflection and could be considered part of emotional intelligence.
Although ephemeral in nature, a curriculum should recognise, nurture, and support the development of clinical wisdom (sometimes called phronesis - a term used by Aristotle to describe the capacity to act with intellectual excellence) to produce a sound and ethical practitioner.

There are other factors that will influence the guiding principles of curriculum design, many of which are external factors beyond the control of the dental school. These can lead to a compromise between what the school may want and what may be possible. These have been represented diagrammatically by Luoto and Lappalainen (23). Here the socioeconomic status of the country and the kind of dental treatment offered for the patients in such a country should be recognised (this means treatment plans for patients in developed countries may be different from those in developing countries). The curriculum design must satisfy the oral and dental health needs of the local population (24).

**Curriculum = Balance**

![Diagram](image)

Adapted from Luoto and Lappalainen (23)

More specifically, motivators for change include:

1. National regulating bodies for dentistry
2. Quality assurance agencies (e.g. European Association for Quality Assurance in Higher Education, ENQA: http://www.enqa.eu/)
3. DentEd /ADEE/IFDEA and the new Global Network
4. National government
5. Changes in dental knowledge
6. Changes in oral and dental diseases and conditions
7. Changes in dental equipment and materials
8. Changes in delivery of oral care
9. Changes in society’s expectations of oral care
10. Changes in understanding of how adults learn
11. University policy and resources
12. School policy and resources
13. Staffing levels and expertise
14. Students
15. Graduates

**Process of Change**

**Restructuring Process**

Curriculum structure is like the skeleton of a body: strong and in balance, giving direction and support to activities and determining the outline of what it represents. It needs careful consideration and planning. The characteristics of the ‘skeleton’ may be determined by the method of teaching, e.g. problem-based learning. It may also be helpful to consider one theme of the curriculum, such as Clinical Dentistry, as the spine around which other themes are arranged. Prior to agreeing themes and arranging them, an overview of the entire transformation is required, including agreement over the theoretical educational framework, the goals and content. In addition, assessment in all its aspects is an essential element of learning and teaching for legal and regulatory reasons, for the benefit of the school and not least for the students themselves. Finally, there are a number of prerequisites when restructuring a curriculum that are essential in order to achieve the desired result and various concurrent actions that either benefit the development of a new structure or can be used as a spin-off.

For instance, restructuring the curriculum in itself takes a substantial amount of time and thus resource. A new structure invariably leads to greater costs because modern educational tools are developed, different physical resources may be required, teaching may be intensified and teachers have to be trained to undertake new methods. For that reason the dental school (and hospital) should estimate the investments required in physical facilities, infrastructure and staff development that will be required. There should be a strategy and associated budget to support curriculum changes. The head of school should not underestimate the amount of time, resource and energy required to bring about change. The normal workload of the leader and/or manager(s) should be adjusted accordingly, and managerial and secretarial support should be provided. One of the most beneficial spin-offs of curricular change is that it often creates teachers with a richer didactic armamentarium. When philosophies of approaches to teaching, methods etc. are changed, teachers have to adapt. This adaptation calls for support in the form of educational training and professional development. In most parts of the world only a minority of academic teachers in dentistry voluntarily follow didactic pedagogic development courses. In changing a curriculum it is possible to create among teachers a self-determined need for pedagogic education and training that will be much more effective than when imposed by higher authorities. A second benefit of a new and innovative curriculum could be the positive impression it creates towards the university and external agencies. This can be helpful in negotiations over budgets, new buildings or new equipment. Therefore, it is essential to disseminate what has been achieved.

Creating a new curriculum structure is a challenge. It requires both leadership and management, with careful planning and a stepwise approach to ensure that the goals are achieved. There should be commitment to change by both the school and the university. Cohen (25) and Kotter and Cohen (26) provide valuable insights into the process of change, with Cohen (25), in particular, giving practical guidance on bringing about change. They show change as an eight-step process:
1. Increase urgency
2. Build guiding teams
3. Get the vision right
4. Communicate for buy-in
5. Enable action
6. Create short-term wins
7. Don’t let up
8. Make it stick

The first stage in the process is “creating a climate for change” which occupies the first 3 steps. The second stage (Steps 4, 5 and 6) is “engaging and enabling the whole school”. This might include some significant external individuals or bodies, such as politicians or organisations responsible for the registration and regulation of the profession. Cohen (25) also provides helpful guidance on the management of barriers to change. The final two steps that make up stage 3 (implementing and sustaining the change) are critical; otherwise the natural entropy (lack of coherence) within a dental school can unravel previous achievements. Whilst these steps have been presented in a sequence, some steps may progress continuously and simultaneously with other steps. Furthermore, Cohen and co-workers suggest that the emotional argument for change is likely to be a more successful lever for change than the logical argument, despite the fact that the logical and analytical approach ought to appeal to a ‘scientific’ audience such as the staff of a dental school. This concept alone will be challenging for those with responsibility for leading the change, not least because people who believe strongly in their motivation and choices for change, cannot imagine that others do not feel the same way.

It is important not to forget students who are following the ‘old’ curriculum. They must not be allowed to feel their course is being de-valued. Much useful feedback can be obtained by piloting appropriate proposed changes with these students and getting their feedback. Support for change from the student body will help win the argument with those less enthusiastic about innovation. Similarly it is important that the leading cohort of students following a revised curriculum is not made to feel as if they are ‘experimental animals’. In addition, day-to-day matters such as timetables and assessment protocols must be issued well in advance so that the leading cohort of students (and staff) are aware of their commitments and responsibilities in a timely fashion. The lack of ‘tradition’ or senior students with advice and experiences to pass on to the leading cohort is particularly unsettling, and good lines of communication between the curriculum planners and the students are essential. Indeed, it is recommended that student feedback on the effect of change to curriculum structure is a formal component of the management of change, with opportunities for students to be informed of the school response to such feedback and to provide reassurance that their concerns and comments have been noted and acted upon where appropriate.

Dental schools will determine their own strategies to take them through the three major stages of change, however, helpful examples of such strategies are:

**Stage 1 Creating a climate for change:**

1. Ask staff, students and graduates to evaluate the existing curriculum, reflecting on the needs of contemporary and future dental practice. Do not focus on change, focus on the appropriateness of what currently exists in terms of education, dental science, clinical practise, student culture and so on; let the need for change evolve from there.
2. Ask the first employers of your graduates on the appropriateness of their employees’ knowledge, skills and attitudes. Beware, however, that these employers will not realise just how inexperienced they were at a similar stage in their career!

3. Use an external body to evaluate the existing curriculum (e.g. DentEd/ADEE site visit).

4. Use the requirements of the Bologna Process.

5. Remember that emotion rather than logic will be a key factor – so collect information about the inappropriateness of the existing curriculum. Comments derived from examples 1 & 2 (above) will be useful.

Stage 2 Engaging and enabling the entire school (staff and students):

1. Use a Delphi approach to involve staff in the planning. The Delphi approach is a technique used for gathering opinion and reaching agreement from amongst a panel of experts (27).

2. Have electronic discussion boards on the University’s VLE (Virtual Learning Environment) or intranet.

3. Have a paper-based version of the proposals in an open-access room where staff/students may visit to see what is proposed and may add comments and ideas.

4. Hold school meetings to disseminate information on the proposed changes.

5. Involve students in the changes, e.g. pilot some of the proposed changes with students on the existing curriculum and record their feedback (a source of good anecdotal material).

6. Ensure that clinical managers and teaching staff funded outwith the university are engaged and are supportive both intellectually and financially; ensure any increase in the use of materials and consumables is identified and funded.

7. Ensure that accommodation for teaching activities will be sufficient and fit for purpose following changes to the curriculum, e.g. number of small group meeting rooms.

Stage 3 Implementing and sustaining the change:

1. Validate the new curriculum within the University and/or the national body responsible for registration, regulation and education.

2. Involve all staff (including auxiliary and support staff) and students in the launch of the new curriculum.

3. Support teaching staff and remind them of their new learning and teaching responsibilities.

4. Maintain a constant and structured evaluation of the new curriculum. The parameters for success should be agreed beforehand and applied at the appropriate moments as the new programme unfolds. The leadership should not be afraid to alter course if things are not working as planned.

5. Maintain a constant stream of positive feedback (it is working!).

6. Disseminate the good news, make staff proud of their new curriculum and ensure research on the results of the change is published. This not only contributes to the annual research output of the school, but also contributes to the pool of educational knowledge and helps others to follow a similar direction.

7. Keep in constant touch with the students to see what their experience has been.

8. If staff are not delivering as expected (within certain limits of autonomy) then seek explanations and encourage them to become more engaged and do what is expected. Student power can be a potent means of sustaining the change.

Leadership and Management
An integral part of this process is further agreement (preferably enshrined in a document) as to who will lead and who will manage the change process, the nature of the relationship between the leader, the manager(s) and other hierarchical figures within the school, what authority they have within the organisation, how it may be used, the establishment of an appropriate committee structure related to curriculum development and secretarial (and other) support. There must be a clear decision making process, and a strategy for the management of conflict. The whole process will fail without the explicit support of the head of school and other senior figures in the institution, e.g. Vice Chancellor or equivalent. Some schools will need to inform the quality committees within their institution that a new curriculum is being developed so that appropriate validation processes can be included in institutional quality procedures.

It is important to involve as many people as possible (see Stage 2, above) because people change more easily when they are involved in the process. One convenient way forward is to establish a number of small ‘Task and Finish’ groups, each with a clearly defined remit; the outcomes of which feed into a higher ‘curriculum change/development’ committee that has a strategic view of the entire process and can prepare material for the higher decision-making body of the school or faculty.

During the process of implementation, results should be monitored, evaluated (as in Stage 3 Point 4, above) and confirmed as a good reason for adoption. This monitoring of outcomes should be reliable, valid and consistent and lead to an ongoing process of reflection and further development – an important aspect of quality assurance of the entire process.

Whilst it is not an excuse for poor planning, the leader and managers should not expect everything to progress smoothly in the first instance. There will need to be a process established for continued adjustment to the curriculum and this mechanism should be incorporated into the school’s ongoing quality assurance process.

Leading and managing such change is beyond the normal expectations of the work of an academic, and there should be suitable recognition and reward.

**Curriculum Design in Practice**

**Educational Philosophy**

In the stepwise approach, following agreement to change the next phase should be the educational context in which teaching and learning is to take place and agreement of the educational philosophy and principles. Examples of a variety of educational philosophy follow, however curriculum developers may pick and choose aspects of any philosophy that will suit their purpose.

The SPICES model of educational principles by Dent & Harden, Chapter 2 (28) provides polarised anchors for consideration:

- **Student centred**
- **Problem based**
- **Integrated / Inter-professional**
- **Community based**
- **Elective driven**
- **Systematic**

- **Teacher centred**
- **Information oriented**
- **Subject / discipline based**
- **Hospital based**
- **Uniform**
- **Opportunistic**
In other words, the curriculum may be Student centred or Teacher centred, Problem based or Information oriented etc. In reality there is no reason why a hybrid approach may not be adopted, which allows the most appropriate pedagogical method to be used under individual circumstances and at different times during the course. Whilst the choices in the left hand column are considered contemporary good pedagogic practice, it should not be assumed without question that this medical model will always be appropriate for dental curricula. For example, clinical practice should not be exclusively community-based/led, and a hybrid approach of hospital and community is appropriate.

The PRISMS model (29):

**Product-focused**  Practice-based wherever possible, acquiring basic science knowledge by solving real clinical problems

**Relevant**  Linking the curriculum to the needs of the learners and to the needs of the population they will serve. This is particularly relevant for those least developed countries

**Inter-professional**  Stressing collaboration and team-working for mutual respect and understanding

**Shorter, smaller**  This anticipates a growth of graduate entry programmes (i.e. students admitted with a degree in a relevant science subject, and pursuing a 4-year undergraduate dental course) with a shorter training period. The pedagogy will move towards teaching in small groups

**Multi-site**  Students will increasingly learn outside the dental school/hospital, where they will encounter and manage the common dental problems under supervision. Students can spend some time with supervisors in an area such as the fluoride-rich east African rift valley

**Symbiotic**  This emphasises the partnership between learners, teachers, organisations and the communities they serve

Another model, specifically dental in origin, has been developed with the acronym CELTIC (30):

**C**  Competency and learning outcome based

**E**  Explicit formative and summative assessment with constructive feedback

**L**  Lifelong, reflective, self-directed learners

**T**  Tactical use of learning and teaching resource that is student-centred

**I**  International outlook, learning relevant to European and world reference

**C**  Credit rated

Fish and Coles (17) describe three models of curriculum design, the Product Model, the Process Model and the Research Model. The Product model is teacher-centred, i.e. the teacher has the knowledge and transmits this to the students who receive it passively. The Process model is a more student-centred model where the teacher provides an environment that is catalytic to self-directed learning by the student. The Research model is also student-centred, and here the teacher learns alongside the student, but remains the leader of the learning group. The latter two models are based upon the constructive alignment principle, which is considered contemporary good practice (12).

It is important to remember that, although the great majority of dental students will eventually work in general dental practice, the curriculum should have broad horizons to reflect the totality of career opportunities in dentistry.
Schools will need to decide if they will include an elective period, i.e. a period of self-selected and self-directed independent learning that would normally (but not necessarily) be related to the world of dentistry. This may be a funded mobility programme such as the EU Lifelong Learning (Erasmus) Programme. The elective period may be distinct from a research project (which aims to provide students with experience in the practice of research and scholarship), or the two may be combined. Permitting students to travel to other countries for their elective can offer them a wider view of the challenges associated with the provision of oral health care.

Transparency of the course may be enhanced by the production of a curriculum map that allows students and staff to visualise the timing of subject/modular teaching. Mobility between institutions will be facilitated by such a scheme if published on the school's website.

The choice of an educational philosophy will be driven by factors that may not be directly under the control or influence of the curriculum planner. For example, resources, culture and ethnographics, and available learning environments. It will be important that the curriculum must recognise the context in which healthcare will be delivered, and that the graduate be sensitive to issues of deprivation and poverty within their country or community. This sensitivity could be achieved by, for example, outreach placements in underprivileged countries or communities. This may have the additional benefit of providing patients access to scarce oral and dental healthcare.

Implicit in the above philosophical models is the need for the school to take a view on the type of teaching it wishes to follow. Many ‘traditional’ dental and medical courses rely heavily upon lectures to transmit information to students. Whilst this is a cost-effective method, doubts have been cast regarding the value of this approach to the learner (31). Small group working has advantages for the learner by allowing discussion of topics and giving the learner the opportunity to develop their own meaning of the information which, in turn, allows further progress towards independence and self-direction (32). It should be remembered, however, that some lectures can be inspirational and some small group work can fail to involve the student. A hybrid curriculum where there is a pragmatic approach to the use of lecture and small group activity may be a helpful compromise. Schools should also consider investing in electronic distance and flexible learning facilities. This can increase both the level and type of interaction with students. Whilst these might be more appropriate for postgraduate education, the increased self-directed learning time referred to in Section 3 (above) will benefit undergraduates also. Furthermore, contacts and formal learning agreements between schools in developed and developing countries may prosper via this route. Leadership and management skills may be developed and enhanced by a group practice approach to clinical education and training.

Schools that have a strong stomatological background for their dental course will need to ensure that only the ‘medical’ aspects relevant to the work of a dentist are given curriculum time (bearing in mind that with an aging population, and with patients who are continuing to live as a result of sophisticated medical procedures and pharmacotherapy, dentists will have to treat increasing numbers of medically compromised patients), and that irrelevant medical subjects do not occupy a disproportionate amount of curriculum time.

Schools will need to make a decision to follow, or ignore, the contemporary practice of early clinical experience, i.e. students meet patients from the outset of the programme. This enables students to feel part of their profession earlier and helps
them to understand the benefit of integration between basic and clinical science rather than spending 2-3 years without involvement in dental subjects. Properly structured this integration can provide opportunity for both learning in context, learning in action and stimulate evidence-based dental practice.

In response to the perceived need to expose students to an environment that is close to the ‘real’ world of work, several schools are developing outreach facilities and activities (33). These may be multi-chair primary dental care centres where students treat patients under the supervision of a qualified dentist, or a Community Dental Service facility, and are akin to the ‘Community-based’ aspect of the SPICES model above.

Phantumvanit (34) has plotted the progression of approaches to dental curriculum design or philosophy from disease-oriented through health-oriented to community-oriented. The author notes that developing countries may lag behind developed countries in their journey towards a community-oriented curriculum, and curriculum detail will be influenced by their country’s historical and professional contacts with various developed countries. A community-oriented curriculum is also a competence-based curriculum, however, due to the different demographic characteristics between developed and developing countries, the competence statements are likely to be different.

Experienced curriculum planners will recognise the existence of 3 concurrent curricula; the curriculum that is written down, the curriculum delivered by staff and the curriculum perceived by the students. A successful curriculum will have substantial overlap of all three (17).

**Vertical & Horizontal Integration**

Vertical Integration means that a topic is revisited throughout the duration of the curriculum, with further information being added to the sum of knowledge year by year; a process termed concentric spiral learning.

Horizontal Integration means that a topic is taught by different groups of staff (perhaps departments or themes) without undue overlap of information, also called thematic teaching. This term might also include learning and teaching of topics between dental undergraduates and dental nurse, dental hygiene, dental therapy and/or dental technology students and would incorporate the concept of teamwork. Using teachers from either the dental school or from the dental nurse, hygiene, therapy or technology staff to deliver topics can lead to economy of resource. This also creates a positive orientation towards team-working among these professions in their future career.

Vertical and horizontal integration can be illustrated by consideration of the topic of Fluoride. In the early stages of the course the use of fluoride in the home environment as a toothpaste may be learned, linked to the delivery of general oral health messages from, say, teachers of Paediatric Dentistry, and which would be common to dental hygiene and therapy students. The biochemical mode of action of fluoride may be delivered through the teachers of basic science. Practical experience of the prescription and clinical use of fluoride can be obtained from attendance on clinic, and include the pharmacology of fluoride supplements. This could be delivered by either teachers of Paediatric Dentistry or oral health with support from teachers of pharmacology, or dental hygiene/therapy. The epidemiology of the effects of fluoride on DMF scores and the arguments for and against adjustment of fluoride in the water supply would complete the topic and might
be delivered by teachers of dental public health. This principle can be applied to all subjects across the curriculum.

A combination of vertical and horizontal integration has been described as a spiral curriculum (35, 36). The advantages of this approach are that topics are re-visited more than once in the programme, there is increasing level of difficulty or complexity on each occasion, the new learning is linked to the previous learning and, as a consequence, the knowledge and skills of the learner increase until competence is achieved.

**Competences & Learning Outcomes**

The next step is the creation of, and agreement over, the profile of the graduate, i.e. planning commences by deciding what knowledge, skills and attitudes you would like your new graduate to possess. From this ‘profile’ the end terms or competences (depending on the educational philosophy) can be developed. Once agreed, a mission statement on the new curriculum may be formulated that should also relate to the mission of the university and school.

Chambers (37) has provided a useful definition of Competence:

‘.... the behaviour expected of beginning independent practitioners. This behaviour incorporates understanding, skills, and values in an integrated response to the full range of circumstances encountered in general professional practice. This level of performance requires some degree of speed and accuracy consistent with patient well being but not performance at the highest level possible. It also requires an awareness of what constitutes acceptable performance under the circumstances and desire for self-improvement.’

Beltrán-Neira et al. have attempted to classify competency statements from several sources from around the world. This is to assist those who are developing such statements for their institution or organisation to rationalise the statements into a coherent and efficient document and hence educational process (38).

Competences are broad statements, usually divided into a number of Domains that outline the knowledge, skills and attitudes of the new graduate. This has been described in depth in The Profile and Competences of the European Dentist (39); they may be considered similar to Aims. Competences may be supported by Learning Outcomes (40, 41). It is good pedagogic practice to review Competences on a regular basis to ensure that the curriculum and graduate are fit for purpose and practice respectively (42).

Assessment of ‘competence’ does not just relate to skill, it also requires appropriate knowledge and attitudes, including self-awareness (i.e. an ability to recognise personal strengths and weaknesses). It also recognises that there is a continuum in the competency spectrum prior to and beyond the point of competence. The graduate should strive to progress along the spectrum from Competent through Proficient to Expert. The whole journey from Beginner to Expert typically takes 10 to 15 years (37).

Learning Outcomes support the competences, are at a greater level of detail, and form the basis of both learning and assessment. Properly constructed, competences and learning outcomes are precisely formulated to indicate what the students should know about, what the students should understand, and what the students should be
able to do and how well, using language and context that indicates the level at which they will be assessed (1st or 2nd cycle, see Appendix 2.1.1). It follows that the Learning Outcomes must be achievable and measurable or assessable. Assistance with the vocabulary of Learning Outcomes can be found at:
http://www.brookes.ac.uk/services/ocsd/2_learnitch/writing_learning_outcomes.html
and
http://www.heacademy.ac.uk/resources.asp?process=full_record&section=generic&id=252

Clark et al (43) have provided a strategic view of learning outcomes, describing a ‘three circle’ model. The inner circle represents what the dentist is able to do (clinical information gathering, treatment planning, treatment procedures), the middle circle represents how the dentist approaches their practice (application of basic science, clinical reasoning and judgement, communication, health promotion, professional behaviour, information handling). The outer circle represents the dentist as a professional (role within the profession and society, personal and professional development). The authors noted that this model can assist with curriculum planning (43).

Learning outcomes should be grouped logically together into modules. A module is a defined (and sometimes self-contained) part of the course, at a specific level, and which attracts credits on successful completion (14). Modules may be composed of a number of units. A modular course structure is a challenge to the philosophy of integration. Dental schools have circumvented this difficulty by a variety of mechanisms. A module description is a fundamental part of the quality assurance process providing transparency for both students and staff. An example of a module description is given as Appendix 2.1.1.

The Level of the Degree will affect the vocabulary of the learning outcomes. Traditionally this level has been at Bachelor level, however, the descriptors associated with the different levels of higher education that have been derived from the Bologna Process suggest that the qualifying degree for dentistry could be easily matched to those at Master (second cycle) level.

The School will need to make an early decision on the graduating level, i.e. Bachelor or Master. ADEE have recommended that schools work towards a Master (second cycle) qualification as this better matches the level at which dental students/graduates are expected to operate (see Appendix 2.1.2).

Assessment and Evaluation

Assessment Strategy

Assessment is often perceived to be an afterthought and a burden at the end of the process of curriculum development. However, in reality it should be the other way around: “You should teach what you assess and assess what you want to train for”. The profile and end terms or competences of the graduate are the initial step. Secondly, the learning experiences that enable dental students to acquire these competences should be determined and facilitated through teaching methods. Thirdly, one should determine how to ensure that students have attained these competences, i.e. how to assess these terms or competences (44, 45). Finally one should adapt the teaching to the assessment process. This way, students always know where, why and what they are working for. This is constructive alignment (12). In reality it is a two-way dynamic process, but assessment (in all its aspects) should always be in the mind of the curriculum developer. Assessment plays a key role in
relation to the structure of the course. It is assessment that makes the student study. Clearly, too many assessments take away the student’s own responsibility and may lead to surface learning. This is a negative and ineffective way to prepare the student for life-long learning. Too little assessment postpones study activity and, whilst students may enjoy this at the time, they will get ‘out of practice’ and find the next assessment much harder to work for.

Assessment in dentistry also has an important ‘gate-keeper’ role by ensuring that the student has the required professional knowledge, skills and attitudes required of professional and statutory bodies. An effective balance between formative and summative assessment also needs to be established.

The content of assessment must be within the boundaries of the learning objectives, outcomes and competences and be at the right level of knowledge: memorizing facts, understanding, and applying knowledge and skills.

Demonstration of learning is complex and involves making the invisible, i.e. the tacit knowledge, skills and attitudes that have been acquired and held inside the student, visible, ie revealed before the assessors for scrutiny and questioning.

It follows, therefore, that the way in which the student is assessed, and the assessment method used, are critical. There are a variety of choices available for assessment (46):

- Formal/informal
- Final/continuous
- External/internal
- Convergent/divergent
- Summative/formative
- Quantitative/qualitative
- Criterion referenced/norm referenced

The following menu of assessment methods can be distinguished (but is not exhaustive):

- Essays
- Modified Essay Questions (MEQs)
- Multiple Short Answer questions (MSAs)
- Constructed Response Questions
- Multiple Choice Questions (MCQs)
- Critical Reading
- Extended Matching Items/ Questions (EMQs)
- Objective Structured Clinical Examination (OSCE)
- Structured Clinical Operative Test (SCOT)
- Patient Management Problems (Unseen Case)
- Clinical Case Presentation
- Short Case Reports (Written/Illustrated)
- Long Case Reports (Written/Illustrated)
- Projects including Research Project, Elective Project, Erasmus Project (individual or group)
- PowerPoint Presentations
- Portfolio
- Tutor Reports
- Self-Assessment
- Multi-source assessment (360° assessment)
Further detail on assessment may be found in Jolly and Grant (47), Case and Swanson (48), Brown et al. (49), Brown and Glasner (50), and Jackson et al. (51).

In a properly planned and harmonious curriculum, the learning objectives, outcomes, teaching methods and assessment methods are in line with each other and provide a comprehensive learning experience. For example, if the teaching of a subject is by way of workshops in which the students discuss topics to understand and apply knowledge, the assessment should not be through a multiple choice exam in which learning of facts is tested.

**Feedback**

Feedback is a fundamental part of the assessment and/or evaluation process. Assessment involves a measurement or judgement of a student's knowledge, skills and attitudes. Evaluation (or appraisal) is an opinion on the course or an aspect of the course, and is a key aspect of the cycle of quality enhancement. Feedback may be obtained from a variety of sources.

teacher → student
auxiliary staff → teacher or directly → student.

Auxiliary staff, (dental nurses, hygienists, therapists, laboratory technicians, receptionists) if they are involved in the education of students, should play a part in the assessment of students. This may be particularly helpful when assessing student attitude and skills in clinical or laboratory environments, and where more conventional forms of assessment are challenging. Patients (or simulated patients in, for example, an OSCE examination) can also provide good feedback to staff. This, in turn can contribute to the assessment process and eventually be part of the teacher → student feedback.

student → student if students act as academic mentors/tutors

Evaluation or appraisal of courses may be:

student → teacher
teacher → teacher (e.g. external examiner, DentEd/ADEE visitation)
employer → teacher.

A reverse flow of information (teacher → employer) can be helpful to allow colleagues outside the academic environment to understand some of the inevitable constraints that exist within an undergraduate course. The importance of feedback in the educational process should be recognised and opportunities for feedback built-in to the curriculum. Properly managed, it should influence further curriculum development.

Feedback has seven principle values (52):

2. Encourages teacher and peer dialogue around learning.
3. Helps clarify what good performance is (goals, criteria, expected standards).
4. Provides opportunities to close the gap between current and desired performance.
5. Delivers high quality information to students about their learning.
7. Provides information to teachers that can be used to help shape the teaching.
Teacher → student feedback should follow any assessment episode (formative or summative), e.g. when assessing a cavity preparation, when marking a written piece of work, when assessing a presentation. Producing a list of marks for an assessed piece of work is insufficient feedback.

There should be a formal mechanism in which each student receives regular written feedback from their teachers on their perceived performance. This should take place a minimum of twice per year, and time should be made available for staff to compile their assessments and for them to discuss these subsequently with students. This may be delivered on an individual basis through a tutor system, and should occur as soon after the assessment event as possible.

Linked to feedback should be a mechanism where support/remediation is offered for the student who is not performing to the appropriate standard. Likewise, the student who is perceived by staff to be performing well should be made aware of their success.

Student → teacher feedback using a formal, or informal evaluation process will enable the student body to express their views, and they will be empowered when their perceived concerns are addressed by the school authorities.

Student → teacher feedback from recent graduates is another means of evaluating the course in an on-going process. The graduates can comment upon how their undergraduate education and training facilitated their ability to work as dental care providers.

Employer → teacher evaluation feedback is important to enable the teacher to remain ‘in tune’ with the needs of the wider profession. This can include feedback from postgraduate trainers and support staff (nurses etc) about the graduates' competences. Feedback from teacher to employer can also help employers understand why students may have perceived deficiencies in knowledge or skill. In turn, employers may support the school in suggesting and introducing change.

Auxiliary staff → teacher feedback is another helpful source of feedback and contributes to a 360° assessment.

Positive or negative outcomes from the feedback on curriculum changes should be communicated to teachers, students, graduate and postgraduate trainers. This ensures an atmosphere of transparency throughout the entire process. Recent evidence suggests that the value of feedback (and audit) must be of the highest quality to have any measurable benefit (53).

Schools should develop a mechanism for the early identification of those students who do not have the aptitude or enthusiasm for a career in dentistry, and assist them in following an alternative career pathway. For those students who have successfully completed the end of year 3 of the programme but do not wish to continue, the school should be able to provide an ‘honourable exit’ qualification that recognises the skills and abilities acquired. The exit qualification is not a licence to practise, nor an opportunity to continue clinical studies elsewhere. This might reasonably fit with the proposed ‘3 + 2’ approach to the undergraduate curriculum leading to qualification at master level (14).

Quality
When implementing a new structure a quality assurance system must be installed or an existing one adapted to the new situation. Quality assurance must make staff and the institution aware of the result of their efforts and it must give students the reassurance that the outcome of monitoring and feedback is not ignored. A system of quality assurance will articulate what outcomes are to be evaluated, when and by whom, as well as identify who is responsible for improvements and within what timeframe. Critically, a process must be in place to ensure any changes agreed are actually implemented, with a further cycle of monitoring established to ensure the changes have actually been of benefit.

The DentEd Taskforce III has produced a document that covers Quality Control, Assurance, Management and Improvement (54) that provides guidance on all aspects of quality.

**Recommendations**

The following are strongly advocated as key aspects of contemporary curriculum development and planning:

- Read widely prior to commencement of the process
- Establish the need and support for change
- Realise that implementation is the most challenging task

The curriculum should have the following features:

- Competency and outcome based
- Student centred
- Learning in context and in action
- Horizontal and vertical integration of subjects
- Patient centred clinical learning and teaching
- Use of best evidence to inform best practice
- Explicit formative and summative assessment with regular constructive feedback
- Use of electives or research projects to facilitate a spirit of enquiry and/or mobility
References


[http://ia300232.us.archive.org/0/items/Constructing_Written_Test_Questions_F or_the_Basic_and_Clinical_Sciences/NBMETestItems.pdf](http://ia300232.us.archive.org/0/items/Constructing_Written_Test_Questions_F or_the_Basic_and_Clinical_Sciences/NBMETestItems.pdf) (Accessed December 2006)


# APPENDIX 2.1.1

**Module: ANATOMY OF THE HEAD AND NECK FOR DENTAL STUDENTS**

<table>
<thead>
<tr>
<th>Code number: DENT0000</th>
<th>Status: Compulsory</th>
<th>Credits: 3 ECTS points (= 81 hours students’ time, 40 contact hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor of the module</td>
<td>Name of the supervisor, name of the Department, name of the Dental School</td>
<td></td>
</tr>
<tr>
<td>Target group</td>
<td>Students in the dental education program, 1st year, 1st term</td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td>1st Cycle (Bachelor)</td>
<td></td>
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</tbody>
</table>

### Aims of the module

- give students an understanding of the structural and functional relationships between the lower jaw, other bones of the skull and cervical vertebrae
- familiarise students with the structures of the temporomandibular joint and the interplay between TMJ, masticatory, hyoid, and neck muscles during the movements of the lower jaw
- familiarise students with innervation and vasculature of the facial and dentoalveolar structures
- familiarise students with the soft tissue structures in the mouth

**Module forms the basis**

- to understand how dentoalveolar structures relate to the rest of the skull
- to begin to see how craniofacial structures are represented on radiograph
- to understand growth and development of the facial skeleton
- to understand TMJ functions and dysfunctions
- to be able to do operative procedures in the dentoalveolar processes and jaws

### Contents


### Teaching methods

A.) Lectures: 10x 2 hours  
B.) Working groups: 5 x 2 hours / student  
Of the working groups two take place in the clinical surroundings. One student acts as patient, one as dentist, one as nurse. The practice is repeated three times allowing each student to act in each of the roles. Two clinical practices are as follows:  
1. palpation of the masticatory muscles and the measurements of the maximal jaw movements, clinical identification of the centric relation position of the lower jaw  
2. identification of the soft tissue structures in the mouth cavity.
<table>
<thead>
<tr>
<th>Learning material</th>
<th>The appropriate parts of the textbook: Moore KL and Dalley AF: Clinically Oriented Anatomy. Lippincott Williams &amp; Wilkins, 5th ed., 2006. Material given during lectures and work groups.</th>
</tr>
</thead>
</table>
| Learning outcomes | A student who successfully completes the module will  
- know names the bones of the skull and can identify their location in the skull and be able to identify the major skeletal structures in lateral x-ray of the skull and in panoramic x-ray of the jaws  
- know the origin and insertion of the masticatory, hyoid muscles and the major muscles of facial expression  
- know the names of the TMJ structures and understand how the condylar head and disc move during jaw opening, lateral and protrusive movements of the jaw  
- know the names and distribution of the major blood vessels in the facial and dentoalveolar area  
- know the names and distribution of the cranial nerves (CN1–CN12) of which CNV, CNVII, CN IX, CN X (in the facial area) and CNXI in detail  
- be able to identify and know the names of the intraoral soft tissue structures |
| Assessment and evaluation | Written examination; the questions require brief essays and/or identification of anatomical names of craniofacial structures. Students are obliged to fill an electronic evaluation questionnaire after the examination. |
| Timing | In the beginning of the 1st term: August-September-October. |
| Prerequisite(s) for attendance | A student needs to have been accepted in the dental education program. |
**APPENDIX 2.1.2**

**The framework of qualifications for the European Higher Education Area**

The Bergen Conference of European Ministers Responsible for Higher Education 19-20 May 2005 adopted the overarching framework for qualifications in the EHEA, comprising three cycles (including, within national contexts, the possibility of intermediate qualifications), generic descriptors for each cycle based on learning outcomes and competences, and credit ranges in the first and second cycles. Ministers committed themselves to elaborating national frameworks for qualifications compatible with the overarching framework for qualifications in the EHEA by 2010, and to having started work on this by 2007.

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>ECTS Credits</th>
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<tbody>
<tr>
<td><strong>First cycle qualification</strong></td>
<td>Qualifications that signify completion of the first cycle are awarded to students who: have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study; can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study; have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues; can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences; have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.</td>
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</table>

<p>| <strong>Second cycle qualification</strong> | Qualifications that signify completion of the second cycle are awarded to students who: have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context; can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field. | Typically include 90-120 ECTS credits, with a minimum of 60 credits at the level of the 2nd cycle |</p>
<table>
<thead>
<tr>
<th>Third cycle qualification</th>
<th>Qualifications that signify completion of the third cycle are awarded to students who:</th>
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<tbody>
<tr>
<td></td>
<td>have demonstrated a systematic understanding of a field of study and mastery of the skills and methods of research associated with that field;</td>
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<tr>
<td></td>
<td>have demonstrated the ability to conceive, design, implement and adapt a substantial process of research with scholarly integrity;</td>
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<tr>
<td></td>
<td>have made a contribution through original research that extends the frontier of knowledge by developing a substantial body of work, some of which merits national or international refereed publication;</td>
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<td></td>
<td>are capable of critical analysis, evaluation and synthesis of new and complex ideas;</td>
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<td></td>
<td>can communicate with their peers, the larger scholarly community and with society in general about their areas of expertise;</td>
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<tr>
<td></td>
<td>can be expected to be able to promote, within academic and professional contexts, technological, social or cultural advancement in a knowledge based society.</td>
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<tr>
<th></th>
<th>Not specified</th>
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of study; have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments; can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously; have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.