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FEATURES SECTION

Current Products and Practices

Curriculum development in orthodontic specialist registrar training: can orthodontics achieve constructive alignment?

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This paper aims to encourage a debate on the learning outcomes that have been developed for orthodontic specialist education. In outcome-based education the learning outcomes are clearly defined. They determine curriculum content and its organization, the teaching and learning approaches, the assessment techniques and hope to focus the minds of the students on ensuring all the learning outcomes are met. In Orthodontic Specialist Registrar training, whether constructive alignment can be achieved depends on the relationship between these aspects of the education process and the various bodies responsible for their delivery in the UK.

Key words: Education outcomes, orthodontic specialist training, assessment

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Introduction

As specialists in orthodontics, we are all involved in education. We educate our patients, their parents, our support staff, each other and ourselves. Traditionally, curriculum design is one aspect of education most of us would not have expected to have any direct involvement in. However, much of the creativity and power in teaching lies in the design of the curriculum. Changes to the curriculum have implications for current and future trainees, teachers on specialist programs and all providers of specialist care. The adoption of a 'learning outcomes' approach to curriculum design may encourage a wider debate on what it is we are trying to achieve in the training of specialist orthodontists?

What is constructive alignment?

Constructive alignment is a concept in curriculum design ensuring that the aims of an education program, the learning outcomes, teaching and learning approaches, assessment techniques and course evaluation all complement each other. This has become a feature of quality judgments made by the Quality Assurance Agency (QAA) in relation to teaching in higher education. The freedom to modify our curriculum is something to be cherished and protected. Choosing what we are trying to achieve, the way we try to get there, what facts are important and which are not, and how to test our students illustrates the power and influence of curriculum design.

What are learning outcomes?

Learning outcomes are becoming more prevalent in the higher education literature. Outcomes are viewed as the middle ground between statements of learning that are considered over-generalized (learning aims) and those that are over-specified (learning objectives).[1]

Learning outcomes for an orthodontist should be developed from an analysis of the professional performance of an orthodontist. This role once defined can be broken down to determine the knowledge, skills and attitudes students must learn in order to fulfill this role. Effective learning outcomes facilitates student

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orientation to the subject, communicate expectations, as well as guiding teaching, learning and assessment strategy.

In higher education, Vaneeta-Marie D'Andrea makes a powerful case for the use of learning outcomes.[2] These allow teachers to clarify course content, teaching approaches, assessment strategy and allows for reflection of all aspects of pedagogic practice. They have also been described as the cutting edge of curriculum developments in medical education as these will place the emphasis on 'what sort of doctor' is produced. Learning outcomes determine the curriculum content, its organization, teaching methods, assessment process and provide a framework for curriculum evaluation.[3] Using learning outcomes in medical undergraduate curriculum design is supported by Hamilton[4] provided these relate, in part, to the mature professional role of the medical graduate and the quality of care provided.

The development of an outcome-based curriculum at Brown University School of Medicine has been described by Smith and Dollase.[5] Brown's approach to the education of medical students begins with the tasks that will be expected of the physician then builds a curriculum design to equip graduates with those attributes.

Who would argue that educational programs should not be based on some idea of what we want students to know or be able to do? Outcome-based education has an intuitive appeal that hooks people in although research documenting its effects is fairly rare.[6]

The need for a core curriculum in medicine, with clearly specified learning outcomes, has been illustrated to focus on the end product and define what the learner is accountable for.[7] This is not about telling teachers how to teach or students how to learn. Learning outcomes determine what is taught and assessed, and can help to identify what is and is not essential. A clear idea of the desired outcomes does not have to be restricting, as the methods of achieving the outcomes are still flexible.

Building on the document produced by the curriculum working party of the SAC in Orthodontics and Pediatric Dentistry in 1996 (version 2H) the SAC have produced learning outcomes for Specialist Registrars and Consultants based on an adaptation of Harden's three-circle model.[3] The dental model adopted in the revised edition of *The First Five Years* differs slightly from the medical model. Clark[8] has recently discussed the advantages of this adaptation of the 3-circle model for dentistry. The starting point for the development of the learning outcomes is the definition of the three essential elements of the competent and reflective practitioner.[9]

The three essential elements are:

- What the orthodontist is able to do (technical intelligences).
- How the orthodontist approaches clinical practice (intellectual, emotional, analytical and creative intelligences).
- The orthodontist as a professional (personal intelligences).

What are orthodontists able to do?

What the orthodontist is able to do contains three key skills: clinical information gathering, treatment planning and treatment procedures. These tasks represent the practical aspect of patient care, but an analysis of the professional performance of an orthodontist will show he/she brings much more than practical skills to the patient encounter. How the orthodontist approaches practice includes application of basic clinical science, clinical reasoning and judgment, communication skills, health promotion, attitudes, ethical and legal responsibility, as well as information handling. Finally, the role of the orthodontist as a professional includes our role in the health service and personal development including a commitment to life long learning (Table 1).

Learning outcomes state what specialist registrars will know or will be able to do as a result of engaging in the learning process. Since the learner's performance should be observable and measurable, the verbs chosen for each outcome must be an action verb that results in an overt behavior. The learning outcomes should:

- be written in the future tense;
- identify important learning requirements;
- be achievable and assessable;
- use language that students can understand and relate to explicit statements of achievement in the context of the performance of the specialist orthodontist.

Blooms taxonomies of learning are useful in helping to write outcomes that take into account deep and surface approaches to learning. Bloom suggested in the cognitive domain the lowest level of learning was factual knowledge or memorization, increasing through more difficult cognitive tasks through comprehension, application, analysis and synthesis up to the highest level of evaluation of information.[2]

Once we have learning outcomes what happens next?

Teachers should ask the questions:

- What teaching methods will I use to encourage students to behave in ways likely to achieve these outcomes?

Table 1 Outcome grid for the specialist in orthodontics

What the Specialist is able to do			How the Specialist approaches Clinical Practice						The Specialist as a profession	
Clinical information gathering	Treatment Planning	Treatment Procedures	Application of basic clinical sciences	Clinical reasoning and judgment	Communication	Health Promotion	Attitudes, Ethical Stance and Legal Responsibilities	Information handling	The role of the dentist within the Health Service	Personal development
•Take a history •Undertake an intra and extra-oral examination of the head and neck •Examine the occlusion •Obtain and interpret relevant clinical, radiological and laboratory investigations	•General Principles •Craniofacial anomalies •Cleft lip and palate •Integrated restorative care •Malocclusion and medical problems	•Appliances: Removable Functional Extra-oral Fixed Retention •Guiding the developing occlusion •Adult orthodontics •Cranio-mandibular dysfunctions •Interface with oral & maxillofacial surgery •Interface with restorative dentistry including Implantology •Interface with paediatric dentistry	•General Principles •Cell and molecular biology •Genetics •Craniofacial embryology Somatic and craniofacial growth Physiology of breathing, swallowing, mastication and speech •Psychology •Dental materials	•General principles •Growth and treatment analysis •Long-term effects of orthodontic treatment •Iatrogenic effects of orthodontic treatment	•Demonstrate active listening skills •Demonstrate appropriate communication skills with a range of patients •Demonstrate appropriate communication skills (verbal and written) with other professional colleagues •Demonstrate appropriate communication skills with others in the dental team in order to ensure efficient and effective working •Demonstrate appropriate case presentation skills, give appropriate advice and information to promote learning in others	•Take into consideration the impact of social, cultural and behavioural factors on dental health •Keep up to date with strategies for prevention of disease in different settings, e.g. primary prevention, screening, public awareness campaigns •Collaborate with other professionals in health promotion and disease prevention •Apply the knowledge, principles and methods of health promotion so as to include an appropriate health promotion dimension to most clinical contacts	•Demonstrate an understanding of patient psychology in relation to health education •Demonstrate an ethical and moral approach (to patients, their relatives, colleagues and staff, and research undertaken) •Demonstrate confidentiality, integrity, truthfulness and respect, without discrimination towards patients and colleagues •Demonstrate an appropriate approach and response to complaints about performance •Recognize and respond to legal responsibilities •Recognize and respond appropriately to colleagues whose professional conduct gives cause for concern	•General principles •Computer-based technology •Critical evaluation of literature	•General •Health and safety •Legislation and ethics •Surgery management •Personnel management •Finance •Audit •Health service structures	•Self-awareness •Continuing professional development •Self-care •Personal growth •Career development •Development of additional experience in areas of efficiency or special interest

- What assessment tasks will tell me that students have achieved the outcomes I intended, in the context of their future role as specialist orthodontists?

Once educational outcomes are clearly specified then decisions about the teaching methods, content, educational environment and assessment procedures are made in the context of these learning outcomes. The learning outcomes must be made explicit and communicated to all concerned, including the students, their teachers, the public, employers and other stake-holders.[3]

An outcome-based approach to specialist training allows curriculum development to keep pace more effectively with changes occurring in orthodontic specialist practice and the delivery of health care. The adoption of a learning outcome approach also encourages a wider debate on which 'learning outcomes' are most important in the artistry of professional practice.

Learning outcomes for orthodontics should be communicated to all specialists to encourage a debate that will serve to strengthen their credibility as a distillation of the skills, knowledge and attitudes that constitute the professional performance of an orthodontist. The ability to reflect on our own actions, articulate what makes a successful performer and the desire to continually improve on that performance is, in essence, what lies at the heart of professionalism itself. Audit and peer review have been a vehicle for reflection, and this is supported by evidence linking reflection and performance in both medical practice and dental education.[10–14]

Learning outcomes: the effect on teaching and learning?

A 'deep approach' to learning is typically identified as an intention to understanding leading to students relating new concepts to existing experience, solving problems and critically evaluating key themes and concepts.[15] This approach to learning through high levels of cognitive processing promotes understanding and long-term retention, facts are learnt in the context of meaning. An outcome-based curriculum engenders more active learning on the part of the students. Encouraging students to find information for themselves, share this with the group and reflect on the information that can be used to solve a problem is most likely to require deep level processing, thinking and, hence, lead to knowledge that is retained in the long term.[16]

Each university will have flexibility in delivery of teaching and learning towards the learning outcomes; however, if the 'logic' of using the learning outcomes approach is followed then that would suggest a change in the traditional delivery of teaching with a move to self-directed learning, problem-based learning, critical thinking and reflection. Teaching clinical skills using skilled practitioners in a safe environment (e.g. Typodonts) followed by close supervision on clinic, allowing the students and teachers to observe each others practice closely is encouraged by the learning outcomes approach.

Learning outcomes: the effect on course content?

Four varieties of curriculum have been described: Content driven, where the emphasis is on developing comprehensive knowledge systems. This is often perceived by students as 'learning facts and passing exams', and reinforces the surface-learning model. Method driven, where primacy is given to one method of delivery of teaching, e.g. problem-based learning. Assessment driven, where the emphasis is placed on success in examinations, but perhaps at the expense of other skills useful in later professional life. Outcome driven, where the emphasis is placed on learning outcomes in knowledge, skills and attitudes derived from professional practice. The outcomes approach is likely to see a reduction in the amount of information students are expected to memorize, but aims to focus attention on that part of the existing syllabus essential to high levels of professional performance.[17]

Learning outcomes: the effect on assessment?

A range of assessment techniques are required to match the outcomes being assessed. These include essays, multiple choice and multiple short answer questions to test knowledge, constructed response questions that assess application of knowledge, checklists, OSCE's and SCOT's, which assess performance and portfolios that assess learning outcomes such as professionalism, not easily assessed by any other method.[18]

Royal Colleges and Universities should be encouraged to look critically at their assessment strategy in the context of the new learning outcomes. The terminal assessment (MOrth), although highly respected as a measure of competence, would need to be modified if a learning outcomes approach was adopted. Outcomes that are difficult to define or hard to measure, but at the same time educationally and professionally significant

should not be omitted because of their supposed imprecision. Creativity, judgment and responsibility must not be ignored because they are qualities that are not readily translated into specific outcomes.[19]

Student perceptions of what is rewarded and what is ignored by formal examination procedures will have a substantial impact on their learning behavior and, thus, upon the outcomes of the course.[20]

To be effective assessment needs to reflect program content and be valid, reliable and fair. Validity can be expressed as face validity, construct validity and impact validity. Face validity is a measure of the appropriateness of the content and the level of the assessment. Construct validity concerns the nature of the broader constructs tested and impact validity is about the impact the assessment has on the behavior of the learners.[20] The validity of an assessment is judged qualitatively, whereas reliability is calculated mathematically. An assessment can be valid and reliable but care must also be taken to ensure that it is fair to trainees. For example, it is well known that examiners vary in their behaviors; there are 'Hawks and Doves'. A fair test will ensure one candidate does not *see* the 'Hawks' all the way through.

Essays or short-answer questions?

Short-answer questions have not been shown to test anything other than that which is tested by an MCQ and are less convenient to mark.[21] The success of the short answer paper will be determined by the careful selection of questions for content and for length of response. To simply ask for a 'definition' would encourage a surface approach to learning and memorization without understanding. Short-answer questions are usually marked against a model answer provided by the question setter. This does not guarantee the accuracy or consistency of the marks, but would seem to be more valid, reliable and fair than the 'traditional' essay format marked subjectively.

Oral examinations: viva-voce

Oral examinations are prone to many errors.[22] These include errors relating to the halo effect, judgment of one attribute influences judgments of others, errors of central tendency and general tendency towards leniency. Errors of contrast, judgments of a candidate are influenced by impressions of preceding candidates. One major weakness of a viva-voce is that, by necessity, it lacks anonymity. Oral examinations tend to test at a low taxonomic level, factual knowledge, rather than problem solving. Scores are related to irrelevant attributes of the candidate, such as appearance or confidence and, hence, agreement between examiners is often poor. It is, moreover, difficult to establish in any formal way the validity of an oral examination. Supporters of the viva-voce claim that the applied problem solving ability of the student is tested—the ability to 'think on one's feet'. However, it might be argued that such skills would be better tested in a clinical environment and the viva-voce may lack authenticity. If communication skills between an orthodontist, patients, parents and colleagues are important, in terms of the orthodontist's professional performance, it would seem reasonable for these skills to be tested directly.

Objective structured clinical examination (OSCE)

The objective structured clinical examination (OSCE)[23] consists of a number of circuits made up of stations through which a candidate must pass. At each station the candidate must perform a clinical task. The candidate is observed and assessed by an examiner. To further improve objectivity the examiner is provided with a checklist breaking the task down to its component parts. In recent years, the use of the OSCE in dental and other health-related professions has been growing in popularity, since it allows for some of the claimed advantages of an oral examination, whilst ensuring a greater degree of equity for candidates in its administration. The cost of staging an OSCE may be higher than some more traditional forms of examination.

Objective structured long examination record (OSLER)

The OSLER is an alternative to the traditional medical long case.[24] Such a change would mean the candidate would be observed examining the patient and aspects of their performance graded against a 'checklist'. This is provided to improve the objectivity and consistency of the examiner.

Structured clinical operative test (SCOT)

Recently, the structured clinical operative test (SCOT) was described.[25] The SCOT is used in Dundee as a formative assessment. Students perform a specific task that is assessed with reference to an agreed set of objective criteria or 'checklist'. This form of assessment has been used to encourage students to develop a self-evaluation and, it is hoped, will encourage high clinical standards throughout an individual's practising lifetime.

Portfolio of learning

Portfolios are a purposeful collection of student work that exhibits their efforts, progress and achievement. The portfolio must include student participation in the selection of contents, the criterion for selection being evidence of self-reflection. A portfolio can demonstrate a level of attainment, progression, professional development and achievement.[26] To be a true portfolio, an index should indicate the contents of the portfolio and include a self-evaluative commentary. Content of the portfolio will be selected by the learner and, therefore, demonstrate reflection by the learner on what they perceive to be the most important aspects of what has been learnt.

Written and oral presentations using critical analysis of clinical protocols or research would be supported by a learning outcomes approach, as would the presentation of a significant number of the candidate's personal treatments particularly if accompanied by a critical reflective commentary on the outcome of care. A portfolio of learning to demonstrate that the learning outcomes had been met might have a more holistic focus, and include outcome data on all completed treatment and a reflection on the candidates clinical training as a whole. Candidates would present a portfolio of evidence to demonstrate their learning outcomes had been met. Teaching and learning activities, and subsequently assessment should encourage a deep approach to new information, processing in the context of existing knowledge and using information to solve problems and perform tasks.

Part of our current assessment system would support deep learning advocated by Biggs.[27] Presentation of your own treated cases demonstrate the skills learnt by students during patients' treatment and candidates are encouraged to reflect on the outcome of care and critically analyse the treatment plan and delivery.

The 'traditional' long case assessment also demonstrates application of knowledge and mirrors professional practice, although the patients vary in complexity and availability. It is possible for two candidates to be faced with very different cases for this part of the examination raising anxieties about reliability and fairness. Objective Structured Clinical Examination (OSCE) may offer an alternative approach with greater impact validity.

The diagnostic examination introduces the concept of time restriction with the candidates and examiners limited to 10 minutes each. This is the part of the examination most of the candidates dread and is seen as a test of character, but the justification for the time factor seems unclear. If a learning outcomes approach is adopted, a direct test of communication skills might be introduced into the terminal assessment. It can be argued that the greater the diversity in the methods of assessment the fairer the assessment is to students.[28]

Critics of learning outcomes

The move in medical education to learning outcomes has attracted criticism from those who feel education should be open ended. McKernan[29] argued 'To define education as a set of outcomes decided in advance of teaching and learning conflicts with the wonderful, unpredictable voyages of exploration that characterize learning through discovery and inquiry'.

Whilst professional competence standards can be very useful sources of information to course designers, it is as well to be aware that their common weakness is a tendency to focus on the technical performance of specific tasks and roles.[30] Learning outcomes may neglect aspects such as the way professionals integrate and manage different tasks simultaneously with other aspects of the job. The way in which they interact with colleagues, clients and the approach they take to solving unfamiliar problems. Hamilton[4] argues the task for the future is to ensure learning outcomes are wide, long and deep. If learning outcomes include technical competency, it is important these are balanced by outcomes in knowledge and attitudes that contextualize these skills. The outcomes are much more than technical competencies and must attempt to capture the essence of the specialist orthodontist.

Can orthodontics achieve constructive alignment?

Constructive alignment is an approach to curriculum design that optimizes the opportunities for quality learning. The key is that the components in the system, especially the teaching methods used and the assessment tasks are aligned to the activities assumed in the learning outcomes. The options chosen for student assessment should be embedded in the teaching methods. For example, in the short diagnostic test, clinical material is looked at for a limited time and then assessed. This approach can also be used as a teaching technique, which ensures the candidates are familiar with the format before the terminal assessment. Consistent with a learning outcomes approach, orthodontists must monitor the methods of assessment to ensure they are consistent with the desired learning outcomes and have the intended educational impact.

Whether orthodontics can achieve constructive alignment depends on the various bodies responsible for delivery of specialist training in the UK. Dialogue between the Universities who select candidates, run programs and have their own summative assessment. The Royal Colleges who hold the MOrth the terminal assessment and requirement for entry onto the specialist list. The SAC who have helped to develop these learning outcomes and the GDC, the sole competent authority over specialist training in the UK. The learning outcomes approach may offer the opportunity to focus the teaching and learning strategy, the assessment at all levels and the minds of the students on ensuring the learning outcomes have been met.

Conclusion

Learning outcomes for orthodontic specialist registrars have been developed. These offer an opportunity for all specialists to reflect on the knowledge, skills and attitude that make up a specialist orthodontist. Learning outcomes may offer an opportunity for orthodontics to achieve constructive alignment of the curriculum and give our students the skills to become competent and reflective specialists.

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