Curricular Design, Review, and Reform

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Box 1.1: Key messages

- Modern veterinary curricula should focus on the fundamental skills required of all graduates and incorporate the principles of learning that will achieve these.
- A curriculum should be designed to be the best fit for the purpose and context of its place and time.
- A curriculum is the totality of student experiences that occur in an educational process, including not only what is taught, but how it is taught, learned, and assessed, how the learning is managed and communicated, and the overall learning environment.
- Curriculum design, review, and reform are complex processes that should involve well-defined steps and input from a wide variety of stakeholders.
- Communication, leadership, a cooperative climate, participation by organizational members, evaluation, human resource development, and politics are all key components in the success of curricular development and reform.
- Curricular evaluation, as an ongoing process for program improvement, should be a component of curricular design and development.

Introduction

Curricular planning, design, and development have always played an important role in veterinary education, but never more so than today. The veterinary degree, perhaps more than any of the other health science degrees, poses a challenge to curricular designers due to the breadth of material that must be covered and the variety of career options available to veterinarians. Modern veterinary curricula also must adapt to a world where information is available at our fingertips, but expanding at a prodigious rate. Therefore, rather than dwelling on past models of learning and teaching, contemporary veterinary curricula must refocus on the fundamental knowledge, skills, and behaviors required of all graduates and utilize modern methods, grounded in educational theory, to best achieve this.

Curricular design can be an arena in which many battles are fought, with differing views
about what veterinary students should learn, how they should learn, what additional qualities we want them to develop, when and how the basic and clinical sciences should contribute to the curriculum, how long the program should take, and ultimately who owns the curriculum. Interestingly, there is no body of evidence demonstrating that there is one best choice for framing a curriculum as a whole, or any of its parts, in either medical education (Grant, 2013) or veterinary education. Instead, a curriculum should be designed to be the best fit for the purpose and context of its place and time. Further, a curriculum should be dynamic; it should be continually developing in response to curricular evaluation as well as changes in professional and societal needs.

In this chapter we have defined what a curriculum is, the factors that may influence its design, and the steps that may be undertaken in order to develop, implement, review, and reform a modern veterinary curriculum.

What Is a Curriculum? Definition and Standards

Definition

There are widely varying views regarding the term “curriculum,” with the word meaning different things to different people. Some people take a narrow view of the term, as frequently found in dictionary definitions: “the courses offered by an educational institution or a set of courses constituting an area of specialization” (Merriam-Webster, 2016). From this perspective, the curriculum may be perceived as largely equivalent to content.

Other people take a wider view, where a curriculum may be broadly defined as the totality of student experiences that occur in the educational process (Wiles, 2009). In this sense, the curriculum is seen as covering not only what is taught, but also how it is taught, learned, and assessed, how the learning is managed and communicated, and the overall learning environment (Harden, 2001). This extended view of a curriculum is illustrated in Figure 1.1 and will be used in this chapter.

Standards for the Curriculum

An alternate way to define a curriculum is through the standards that accrediting agencies require. One example of these standards is that developed in the United States by the American Veterinary Medical Association’s (AVMA) Council on Education (COE). Standard 9, which addresses the curriculum, is one of 11 standards outlining the requirements that colleges or schools of veterinary medicine must meet in order to become accredited (AVMA, 2014).

![Figure 1.1 Curricular elements.](image-url)
Table 1.1 Factors influencing curricular design and their effects.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Specific Influence</th>
<th>Effect</th>
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<tbody>
<tr>
<td>Academic</td>
<td>Theories of learning</td>
<td>Learner-centered design (e.g., problem-based learning); integrated curricula</td>
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<td></td>
<td>Expansion of knowledge</td>
<td>Core and elective curricula</td>
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<td></td>
<td>Decreasing resources</td>
<td>Distributed clinical teaching</td>
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<tr>
<td>Professional</td>
<td>Veterinary practitioners</td>
<td>Inclusion or expansion in the curriculum for communication and business skills; emphasis on teamwork and professionalism</td>
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<td></td>
<td>Accreditation and licensure</td>
<td>Outcomes-based curricula; focus on competencies; changes to curricula due to changes in licensing exams, e.g., North American Veterinary Licensing Examination (NAVLE)</td>
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<tr>
<td>Societal</td>
<td>One Health</td>
<td>Multiprofessional elements</td>
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<td></td>
<td>Social values</td>
<td>Widening-participation curricula to address underserved areas or communities; fewer animal use courses and introduction of clinical skills laboratories</td>
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<tr>
<td>Political</td>
<td>Length of curriculum</td>
<td>Shorter curricula, or earlier entrance to Doctor of Veterinary Medicine programs, to address cost of veterinary education</td>
</tr>
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Source: Adapted from Grant (2013). Reproduced with permission of Wiley Blackwell.

Standard 9 states that the curriculum in veterinary medical education is the purview of the faculty of each college, but must be managed centrally based on the mission and resources of the college. Additional points in this standard include the requirement that the curriculum extends over a period equivalent to a minimum of four academic years, with a minimum of one academic year of hands-on clinical education; the subject areas that must be covered in the curriculum are defined, but it is not prescribed as to when or how these subjects should be taught or assessed; and the curriculum as a whole must be reviewed at least every seven years. More information about this standard, and those of other agencies that accredit veterinary colleges and schools around the world, can be found in Part Five, Chapter 22: Accreditation.

Factors Influencing Curricular Design

Curricular design is a complex process and may be influenced by a variety of factors internal and external to a college or school of veterinary medicine. These factors may include academic, professional, societal, and political influences (see Table 1.1).

Some of these factors affect the content of the curriculum and others affect curricular design. For example, emerging theories on adult learning can result in different curricular models, and changing expectations of the veterinary profession may cause alterations in the content of the curriculum. As Grant observed, “At any one point, a curriculum is a child of its time” (Grant, 2013, p. 36).

Steps in Curricular Design and Development

Veterinary medical educators now appreciate that curricular design encompasses much more than a statement of the content to be covered in the course or program. Instead, curricular design is a rational, open, and accountable process that may cover all aspects of a curriculum, or may focus on a specific area where curricular revision and renewal are desired. Development of a curriculum can be a lengthy process and
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usually involves a team of individuals who bring to the table different expertise, such as content specialists; basic, paraclinical, and clinical faculty; students, educationalists, administrators, or managers; and external stakeholders such as veterinary practitioners.

Recently, Harden outlined a comprehensive, 10-step process used for curricular design in medical education (Harden, 2013). These steps have been employed as a framework for this chapter, as all the steps are equally relevant to veterinary education, with some modification for the different educational contexts. Further, these principles of curricular design are fundamental, yet flexible enough to yield different types of curricula in different hands, depending on the local environment in which veterinary curricula are developed or reviewed. This last point is very important, as it is not the intent of this chapter to describe a “cookie-cutter” curriculum that is suitable for all veterinary programs regardless of their location or available resources. Rather, we have included the essential guiding principles that should be applied to achieve optimal student learning outcomes and to result in veterinary graduates who are prepared for the future challenges of our profession.

Although these steps are discussed serially, in real life many of the decisions occur in parallel, or in a different order. This rearrangement is acceptable, as the steps are ultimately interdependent and the timing of their development may be a function of the college or school’s needs or resources. It should also be noted that many of the items mentioned in these steps are discussed in greater detail in the chapters that follow.

**Step 1: Identify the Overall Purpose of the Educational Program**

The first step in curricular design should involve the preparation of a document that includes an ideological mission statement, expressing values, beliefs, and aspirations for a program. These values and aspirations should be derived from the professional, social, political, and cultural contexts of the institution (Grant, 2013). In this way, emerging local needs can be specifically identified and addressed in the curriculum, and may help counterbalance a sole focus on the requirements of national and international standards. Examples of mission statements applicable to veterinary programs can be found on the websites of many veterinary colleges.

When approaching curricular planning, there is a temptation to assume that there is a shared understanding of the overall purpose or aim of the program. However, unless the terms that are employed are defined and are specific, misunderstandings will arise (Leinster, 2013). For example, it is unhelpful to have the stated aim of a program to be to “produce a good veterinarian,” as this is too vague and begs the question of how a good veterinarian is defined!

**Step 2: Determine the Specific Student Learning Outcomes or Competencies**

One of the major emerging themes in medical education has been the recognition that curricular design should begin at the end (backwards design). In other words, the outcomes of the educational process should be specifically determined, then the curriculum designed to achieve these outcomes. This is in contrast to earlier approaches, where the content that faculty believed should be taught was arranged without regard for the end product. Implicit in this forward-thinking, input approach is that the focus is on the educational process regardless of the outcome.

This method utilizing backwards design began in the late 1980s, but has become more popular in the 2010s. However, there has been considerable debate regarding the definition of the end product, the most common terms being objectives, attributes, outcomes, and competencies. Specifically, people have argued about what the terms mean, how they differ, what they imply, and how they should be used. Of these terms, competencies have predominated in medical education and competency-based medical education (CBME) is now a primary driver for curricular planning (Harden, 2014). A similar movement has begun in veterinary education,
and a number of competency frameworks relevant to veterinary practice have been developed in recent years (Bok et al., 2011; Shung and Osburn, 2011; AVMA, 2014; RCVS, 2014).

In common curriculum parlance, a competency is a specific area of performance that can be described and measured (Sklar, 2015). Thus, the emphasis has shifted from “what the student knows” and “what the teacher does” to “what the student does” (Corbett and Whitcomb, 2004). This system has the added advantage of allowing student achievement to determine advancement, so that progression is defined by the demonstration of required competencies, rather than by time spent in a program (Prideaux, 2016).

However, CBME is not without its critics, who argue that this is a reductionist approach with a focus on the parts rather than the whole (Brooks, 2009). As a result, this educational model may have difficulty capturing the complex requirements of medical practice or the central skills of professional judgment, decision making, and clinical reasoning (Grant, 2013). Further, some critics believe that competency frameworks are too theoretical to be useful for teaching and assessment in daily practice.

In response to these concerns, entrustable professional activities (EPAs) have recently been developed to work in tandem with competencies to produce a more ‘holistic’ basis for curricular design (Prideaux, 2016). Further information about CBME, especially how it relates to veterinary education, can be found in Part One, Chapter 2: Competency-Based Education.

**Step 3: Determine the Content to Be Included**

Historically, the starting point for curricular design and development was often content; that is, what faculty believed should be taught. However, there are two fundamental fallacies with this approach: teaching is not synonymous with learning, and the possession of knowledge of an area does not guarantee the ability to perform in that area (May and Silva-Fletcher, 2015). A shift to competency-based educational models helps address this problem, as these models are based on clearly defined and measurable competencies, together with student demonstration that these have been achieved. In this way, the required competencies, rather than individual faculty expectations, drive curricular content.

This focus on competencies is particularly important in the age of the Internet and the expanding information available for learners. It is clear that curricular content can no longer include all the knowledge available in veterinary education. Furthermore, the length of time available for Doctor of Veterinary Medicine (DVM) programs (usually four years post degree, or five to six years post high school) is unlikely to lengthen given the concerns surrounding student educational debt. Therefore, the underpinning knowledge needed for students to develop the required competencies has to be identified, thus creating logical priorities for the content to be included in a curriculum.

There are a number of specific issues in relation to this point that deserve greater discussion.

**Core and Elective Curricula**

One model that is gaining some traction in veterinary education, and that may help with the expansion of knowledge, is a core/elective or core/tracking/elective curriculum. These curricula identify the content that is deemed to be core and that all students must acquire, then allow students to choose additional courses to gain deeper knowledge based on their personal preferences and career goals. In a tracking curriculum, the additional courses are determined by the specific track on which a student wishes to focus, for example livestock, small animal, or public corporate. Alternatively, all additional courses may be optional.

In this model, the first requirement is to determine what is core, with optional material being determined by the resources available, for example faculty interest and expertise. As discussed earlier, the core content should focus on the required competencies, but the issue remains of how to determine the competencies that should be core for all students. A number of ways have been used in medical education to
answer this questions, ranging from modified Delphi processes and other formal consultations to statistical and epidemiological methods, or more informal consultation with various stakeholders (Grant, 2013). One approach that is gaining traction in medical schools is the identification of index cases or presentations that are based on the different ways in which the population comes into contact with healthcare professionals (critical incident technique; Pavlish, Brown-Saltzman, and So, 2015). The core knowledge and skills that students need within each discipline are determined by what they need to know and do in order to understand and manage these core clinical problems.

Whatever method is chosen, care should be taken that the content reflects a consensus of views, including those of specialists and generalists. Specialists alone should not be permitted to determine the core curricular content in their own discipline (Leinster, 2013). The core content should be well understood and publicized, and take into consideration the vision of the college or school and the timeframe available for delivery of the core material. Finally, this process must include consideration of accreditation requirements as well as materials that will be included in licensing exams, such as the NAVLE.

Content Overload
One of the major concepts to emerge from educational research in the last 40 years is the idea that students take different approaches to learning (Marton and Saljo, 1976). Briefly, students who take a deep approach have the intention of understanding, engaging with, operating in, and valuing the subject, while students who take a surface approach tend not to have the primary intention of becoming interested in or understanding the subject, but rather their motivation tends to be jumping through the necessary hoops in order to acquire the mark, or the grade, or the qualification (Biggs, 1999; Lublin, 2003). The enemy of deep learning in any discipline is content overload (Ramsden, 1992), which leads to the superficial acquisition of facts, overwhelming any drive toward understanding and extracting meaning (May, 2008; May and Silva-Fletcher, 2015).

In conjunction with a competency-based approach to delineate and prioritize the core content to be included in a curriculum, the process of curricular mapping may assist with content overload. A comprehensive curricular map allows identification of material that should be included, as well as any uncoordinated rather than planned repetition, and, most importantly, redundant material that is irrelevant or not required. More discussion on curricular mapping can be found in Part One, Chapter 3: Curriculum Mapping.

“Just in Time” versus “Just in Case”
Another concept gaining increased attention in health sciences education is “just in time” teaching as opposed to “just in case”. This concept acknowledges the greatly expanded knowledge available on the Internet and the important skill of information literacy, with which students are able to source and evaluate this information correctly. In this way, students can apply or adapt the information in appropriate contexts when it is needed (“just in time”). This compares to the more historical approach in transmission-focused models of veterinary education where faculty take sole responsibility for sourcing the information that they determine to be needed, verify the quality of the information, and ask students to remember it “just in case” they might one day require it. The “just in time” model still acknowledges that essential concepts are core, but these act as frameworks for knowledge sourced on a “just in time” basis in response to a specific challenge (May and Silva-Fletcher, 2015).

Step 4: Determine the Organization of the Content, Including the Sequence in Which It Is Covered
Once the content of the curriculum has been determined, the next step in curricular design is to decide how this content will be organized within the allotted timeframe. There is no absolutely correct order for courses in a veterinary
curriculum, but there should be a transparent logic behind the arrangement. In addition, there may be some constraints that determine how much time may be allocated to a specific topic or subject area, and where in the curriculum it should be taught.

The first of these constraints may be the course structure of the university, which may influence how much time can be allocated to a course. For example, a university may have a credit system where a credit equates to a set number of hours of lectures and/or laboratory classes. In these situations, the subject area is allocated a number of credits that is roughly based on the content to be covered, but does not take into account the amount of time specifically required. For example, a subject may be given one credit, which might be equivalent to 15 hours, but only 10 hours may be required to cover the core material. However, with a credit system, all 15 hours would be dedicated to this subject. Such a situation may be exacerbated by systems where courses are traditionally “owned” by departments and the heads of department allocate the teaching time to members of the faculty as part of their teaching effort assignment, and the latter then fill the lecture and practical classes with material at their discretion. These courses may also be taught in isolation, without regard for the content of other courses. Taken together these processes may result in fragmented curricula, with omission, duplication, and particularly redundancy, together with non-coherent skill development.

Solutions for these issues could include larger, integrated courses, which may give more freedom for appropriate allotment of the time required for individual subjects or disciplines within a course. In addition, this process should be controlled at a college level, where a central course design team works together with discipline experts to ensure appropriate time allocation, correct sequencing of content, lack of duplication, omission, and redundancy, as well as progressive skill development. In this way, the teachers who will be delivering the curriculum still feel that they have a stake in the course and have been involved in decision-making, but the decisions are ultimately made through a consensus process involving a multidisciplinary group.

The second issue is how the courses are organized within the curriculum, and a decision must be made whether to use a more traditional modular model, or an integrated approach. These options are not mutually exclusive, nor is one approach necessarily preferable to the other, and many curricula display elements of both depending on the resources available.

Modular Curricular Design
A module is a self-contained course or unit of study. The course should have its own outcomes or learning objectives, activities, and assessments. In most veterinary curricula, students take more than one course at a time, with the courses taught conjointly and with a logical timing and sequence. Further, the timing of the courses should be planned according to a rational progression of knowledge and skills through the curriculum, although this may also be dependent on the availability of resources. Currently, a modular design is the most common curricular model in veterinary education.

A downside to this model is that knowledge and skills may be presented in isolation, with integration of subject areas occurring later, often by the student themselves, through use of the concepts in clinical settings.

Integrated Curricular Design
One organizational model that is becoming increasingly popular in medical education is an integrated curriculum. At its most fundamental, integration is the organization of teaching material to interrelate or unify subjects frequently taught in separate academic courses or departments (Malik and Malik, 2011). This approach helps students combine the facts they have learned and develop holistic approaches to medical problems.

The adoption of an integrated model may involve either a significant or a complete reorganization of the curriculum, so decisions must be made about the framework around which the content will be integrated. Different
approaches to achieving integration have been used with varying degrees of success, but the most common involve either vertical or horizontal integration or a mixture of both. These models, together with other models of integration, are discussed in greater detail in Part Two, Chapter 5: Integrated Learning. It must also be remembered that whatever the final structure of the course, integration can only take place at the level of the students’ experience of learning. There is no point in integrating topics that are not coherent in their approach and level of difficulty.

Spiral Curriculum
Another organizational strategy that is frequently employed in curricular design is the concept of a spiral curriculum. The principal features of a spiral curriculum are the following:

- Topics, themes, or subjects are revisited on a number of occasions throughout the curriculum or program.
- Topics are revisited at increasing levels of difficulty.
- New learning is related to prior learning.
- The competence of the learner increases with each visit to the topic (Harden, 1999).

This spiral arrangement means that important themes are revisited, with continual development and reinforcement, over the duration of the program. Only by building a curricular structure based on increasing student challenge can progressive knowledge and skill development be fully realized (May and Silva-Fletcher, 2015).

Table 1.2 The SPICES model for educational strategies.

<table>
<thead>
<tr>
<th>Innovative</th>
<th>Traditional</th>
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<tbody>
<tr>
<td>Student-centered</td>
<td>Teacher-centered</td>
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<tr>
<td>Problem-based</td>
<td>Information-oriented</td>
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<tr>
<td>Integrated or interprofessional</td>
<td>Subject or discipline-based</td>
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<tr>
<td>Community-based</td>
<td>Hospital-based</td>
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<tr>
<td>Elective-driven</td>
<td>Uniform (or core)</td>
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<tr>
<td>Systematic</td>
<td>Opportunistic</td>
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learning, is intellectually critical, stimulating, and challenging, but within a learning context that emphasizes support and mutual respect (Grant, 2013). This shift away from teaching and toward learning is at the root of curricular models such as problem-based learning (PBL).

Inquiry-Based Learning versus Information-Oriented Learning
In order to achieve optimal learning outcomes, students should be actively engaged in their own learning. Strategies developed to try to optimize student engagement have included PBL and allied learning approaches (e.g., case-based learning, team-based learning, and task-based learning). In these learning paradigms, students explore scientific concepts in the context of clinical problems (or cases or tasks) and, rather than being provided with the knowledge (information-oriented learning), they establish their own knowledge and use it ultimately to solve clinical challenges. In this way, inquiry-based learning allows students to make connections between prior knowledge and new information, especially in the context of how they will use the information, and this facilitates knowledge storage and retrieval.

Problem-based learning, and allied strategies, may be employed in small groups, large groups, individualized learning, or with students working at a distance. The group approaches to learning are discussed further in Part Two, Chapter 6: Collaborative Learning. In addition, Harden and Davis developed 11 steps or stages that can be recognized in the continuum between inquiry-based learning and information-oriented learning (Harden and Davis, 1998).

Integration versus Subject- or Discipline-Based Learning
As discussed earlier in this chapter, medical education has moved from structuring the curriculum around the disciplines, first in basic sciences then in clinical medicine, to models where these are integrated.

In addition to integration within a curriculum between disciplines (horizontal integration) and between the basic and clinical sciences (vertical integration), there is also a move to interprofessional teaching, where integrated teaching and learning involve different healthcare professionals, and where students look at a subject from the perspective of other professions as well as their own. This concept is discussed further in Part Two, Chapter 7: Teaching Interprofessionalism.

Community-Based Learning versus Veterinary Teaching Hospital
Traditionally, clinical teaching in veterinary programs has largely been conducted in veterinary teaching hospitals (VTHs) that are owned and run by a college. In these hospitals, significant emphasis is placed on specialty practice with secondary or tertiary patient care. More recently there has been a recognition that these experiences may not provide veterinary students with sufficient exposure to common or routine clinical cases and there has been a move toward primary care or community practices. These clinics may be situated within VTHs, within off-site practices owned by the college, or in practices at large that have partnered with colleges to provide this clinical learning experience.

There is more detailed discussion of the learning that may occur in veterinary teaching hospitals in Part Three, Chapter 12: Learning in the Veterinary Teaching Hospital, and that in community-based practices in Part Three, Chapter 13: Learning in Real-World Settings.

Elective versus Core
The curricular strategy involving core and elective courses has been discussed earlier in this chapter. As noted, electives are now firmly established as a valued component of the curriculum in most veterinary colleges and are important contributors to the individual student’s learning outcomes. The main driving force for their development is that it is no longer possible for students to study in depth all topics in a curriculum, and elective courses offer students an opportunity to study areas of interest to them in greater detail and within the resources of the college.
Systematic versus Opportunistic Approach
This strategy refers to curricular planning in which an opportunistic approach involves faculty teaching what is of interest to them, and the cases to which students are exposed in the clinics are those that happen to be available (Harden, 2013). Once a curriculum becomes competency or outcome focused, this paradigm must shift to a more systematic approach to curricular planning to ensure that students have learning experiences that match the expected learning outcomes and that the core curriculum includes the competencies essential for graduation.

Scaffolded Active Learning in Veterinary Curricula
One curricular strategy that has been advocated to suit veterinary medical education is “scaffolded active learning” (May and Silva-Fletcher, 2015). In this model, core knowledge is provided through framework lectures, then additional knowledge is attained through context-related problem-solving, involving collaborative learning and case-based exercises, or self-directed learning. The intention of the model is that the interest stimulated by context-related problem-solving, and the associated active learning, will build on the framework knowledge, thereby allowing personal and integrated knowledge construction in a way that is similar to, but more efficient than, PBL. There are nine pedagogical principles that further underpin this model (see Box 1.2). This model of teaching has been developed in a number of veterinary colleges and schools (May, 2008; Jaarsma, Scherbier, and van Beukelen, 2009; Howell et al., 2002).

Step 6: Determine Learning and Teaching Methods
Decisions about the learning and teaching methods to be used in a curriculum should flow from the planning of previous stages. For example, if a curriculum is to be student centered and problem based, then learning methods that encourage these approaches should be used.

It should be remembered there is no holy grail of instructional wizardry that will always provide an optimal learning outcome. In general, however, the teaching methods used in a curriculum should promote active rather than passive learning. Active learning occurs when students engage in activities that promote analysis, reflection, and problem-solving. Further, any educational method that includes an appropriate motivational context, a high degree of learner activity, interaction with peers and teachers, and a well-structured knowledge base will encourage a deep approach to learning. Conversely, any teaching or learning method, whether apparently learner centered or not, that has a heavy workload, high contact hours, excessive material, or an emphasis on coverage

<table>
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<tr>
<th>Box 1.2: Focus on the pedagogical principles underpinning scaffolded active learning</th>
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<td>May and Silva-Fletcher (2015) have offered a veterinary curricular model that promotes effective problem-solving, integrated knowledge, and clinical reasoning. This model is underpinned by nine pedagogical principles:</td>
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<tr>
<td>1) Outcomes-based curriculum design.</td>
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<td>2) Valid and reliable assessments.</td>
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<td>3) Active learning.</td>
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<td>4) Integrated knowledge for action.</td>
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<td>5) Tightly controlled core curriculum.</td>
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<td>6) “Just in time” rather than “just in case” knowledge.</td>
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<td>7) Vertical integration, the spiral curriculum, and sequential skills development.</td>
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<td>8) Learning skills support.</td>
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<td>9) Bridges from classroom to workplace.</td>
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is likely to push students toward a surface approach to learning (Grant, 2013).

Good teachers facilitate student learning by using a range of methods, and applying each method where most appropriate. This decision may also be influenced by the efficiency of the method, as well as its effectiveness and authenticity. Some of the methods that may be used for learning and teaching in veterinary curricula are briefly described in what follows. Further details are provided in other chapters.

Lectures and Whole-Class Activities
Lectures and whole-class teaching remain powerful and efficient tools if used properly. Their primary role is often information transfer, in situations where foundational knowledge is needed. In these cases, active learning may be encouraged with the use of classroom exercises that promote engagement, such as short quizzes and quick peer discussions. There are a number of programs available that may help with these activities, for instance audience response systems. Alternatively, group-based, clinical problem-solving activities can be planned around the whole class, as described in team-based learning (Michaelsen, Davidson, and Major, 2014).

Small-group activities
Small-group work facilitates interaction between students and makes possible cooperative learning, with students learning from each other. Small-group work is usually an important element in problem-, team-, or case-based learning.

Self-Directed Learning
This form of learning can make an important contribution to an educational program. Students master the area being studied, while at the same time developing the ability to work on their own and take responsibility for their learning; both are important traits for lifelong learning.

E-learning
A significant development in recent years has been the application of new learning technologies within veterinary curricula, including simulations and e-learning. Computers may be used to access learning management systems; listen to lectures in real time or after delivery (i.e., lecture capture); as a source of information, for example in flipped classrooms; to present interactive patient simulations; to support collaborative or peer-to-peer learning; or to deliver entire courses (online courses).

To date, no veterinary curricula have been delivered entirely online; rather, most curricula have a blended model where some courses, or course material, are delivered online through learning management systems, and other parts of the curriculum are delivered in the classroom or laboratories. Further, the use of devices such as smartphones and tablets has increased the opportunities for learning within clinics, where students can access resources just prior to, or just after, seeing a patient, facilitating “just in time” learning. It is anticipated that these e-learning activities will continue to expand in the future.

Laboratory Classes, Including Animal-Use Courses
The learning that occurs in the laboratory or practical class remains an important part of veterinary education, although it is on the decrease in medical education. Laboratory classes provide necessary hands-on experience and help develop the essential technical skills required of a Day One veterinarian.

Laboratory classes remain a significant proportion of some of the basic science courses, for example anatomy, as well as medical and surgical courses. However, the materials used in these classes can constitute significant resources and must be taken into account when planning a curriculum. Further, a decision should be made as to the involvement of live animals in these classes, and this may be influenced by national or state legislation.

Learning in Clinical Skills Laboratories and Simulations
Another recent development in veterinary education is the emergence of clinical skills laboratories. These facilities allow students to
practice a range of professional and technical skills in a safe and non-confrontational environment, before performing them in "real-world" settings such as the VTH or other veterinary practices. In addition, assessment of these skills, often in the form of objective structured clinical exams (OSCEs), can be developed to evaluate these skills in both formative and summative ways, and to allow students to gain feedback on their performance.

**Learning in Veterinary Teaching Hospitals and Distributed Sites**

An important component of veterinary education is the learning that occurs in the clinical environment. Often this is situated in VTHs that are part of a veterinary college or school, although increasingly this experience is occurring in distributed sites and practices. Both situations may offer effective integrated teaching and are essential for the development and refinement of clinical reasoning and problem-solving.

**Step 7: Determine How the Student’s Progress Will Be Assessed**

Much more will be written about assessment of the student later in this book (Part Four), but from a student’s point of view, assessment always defines the actual curriculum (Ramsden, 1992) and as a result drives learning. There are several assessment principles that should be adhered to when developing a curriculum.

**Blueprint Valid and Reliable Assessments within an Assessment Program**

When considering the assessments to be included in a curriculum, emphasis should not be placed on convenience or cost-effectiveness, but rather on whether the assessment task can reliably and validly assess the competencies that have been articulated. This constructive alignment of assessment tasks with learning outcomes or objectives, as well as with learning activities designed to teach the outcomes, is fundamental to any level of a well-designed curriculum (learning session, course, module, or the entire curriculum).

The range of knowledge and skills the modern veterinary graduate requires cannot be captured by a single measurement type and, in particular, technical skills cannot be assessed through written formats. Increasingly, veterinary schools are using a variety of assessment formats that collectively form a program of assessment that targets core knowledge, scientific and clinical reasoning and decision-making, and practical skills. At a curricular level, the assessments should be blueprinted during the planning and development phase. This process will ensure coverage of all required competencies, using appropriate valid and reliable measures, and, when evaluated together, assures a college that its graduates have the intended learning outcomes (knowledge, skills, abilities, and professional aptitudes) for a Day One veterinarian. The blueprint should include what should be assessed, how it will be measured, aims of the process (summative or formative), when the assessment should occur, and who will conduct the assessment (student or self-assessment, faculty, licensing body).

**Determine the Level of Learning to Be Attained**

When evaluating the assessments to be developed, it is important to remember to include the level of learning that is desired. This level of learning may be represented in a number of ways, but a common taxonomy used across higher education, which is equally applicable to veterinary education, is Bloom’s revised taxonomy (Krathwohl, 2002). This taxonomy identifies six different levels of cognitive processing with increasing complexity (remember, understand, apply, analyze, evaluate, and create). The specific cognitive processes that further clarify the boundaries of these six categories have also been defined (Anderson and Krathwohl, 2001).

Although Bloom recognized the psychomotor domain in addition to the cognitive and affective domains, it was not included in his taxonomy (Leinster, 2013). However, a similar grid can be used to define the learning outcomes in relation to clinical skills that the student must acquire within a program. This grid is commonly
expressed in the form of Miller’s pyramid, with the outcome levels ranging from “knows how” to “mastery” (Miller, 1990). An illustration of Miller’s pyramid is included in Part Four, Chapter 16: Performance and Workplace-Based Assessment. In curricular planning, the necessary clinical skills, as well as the expected levels, should be specified.

**Step 8: Communicate the Curricular Design and Principles to All Stakeholders, Including Students**

As already stated, designing a curriculum is a complex process and should involve documentation of the methodology, quality assurance, and recognition of all stakeholders. Failure to communicate the intended outcomes of the curriculum, and how the design and learning methods will achieve these outcomes, is a recipe for problems during curricular design and/or revision.

Communication may be in many forms and to a variety of stakeholders. Particular attention should be provided to communication with students, who should have a clear understanding of what the learning outcome should be at every level of the curriculum, the range of learning experiences and opportunities provided to help them attain these outcomes, how they may shape their learning experiences to suit their personal needs, and feedback as to whether they have attained the required outcomes (Harden, 2013). Documentation that may help to communicate this information can include course syllabi, course study guides, a curricular map, and a handbook of student policies and procedures that includes guidelines for academic progression.

**Step 9: Include Consideration of the Educational Environment**

Increasingly in medical education there is a realization that the educational environment, or “climate” in which student learning takes place, is a key aspect of the curriculum (Genn, 2001). Traditionally, a curriculum has been described through the content outlined in the syllabi and the listed topics that are covered in lectures, laboratory classes, and other learning opportunities. However, what is learned in a program is rarely solely that which is stated within an institution's documents. Rather, the curriculum may be thought of as the “taught curriculum” (what the student is taught), the “learned curriculum” (what the student learns), and the “hidden curriculum” (the student's informal learning that is different from what is taught). In particular, the hidden curriculum is influenced by the educational environment in which the learning takes place. Further information about this topic is included in Part Seven, Chapter 33: The Hidden Curriculum.

Measurement of the educational environment should be part of ongoing curricular evaluation. Tools are available to assess the educational environment, such as the Dundee Ready Education Environment Measure (DREEM; Roff, 2005), and have been validated in veterinary programs (Pelzer, Hodgson, and Werre, 2014). More information about this and other tools used to assess the educational environment is provided in Part Seven, Chapter 32: Student Learning Environment.

**Step 10: Determine How the Curriculum Will Be Managed, Including Resource Allocation**

With the increasing complexity of veterinary education, attention to how a curriculum is managed has become more important. This complexity includes the traditional resources that may be required to support a veterinary curriculum, such as sufficient numbers of faculty and staff with appropriate qualifications across all major species and subject areas; access to appropriate facilities, including lecture halls that are big enough to hold the entire class at one time and have appropriate information technology resources; laboratory spaces, animal handling facilities, and clinical skills laboratories; and VTHs that are either included within the college or distributed in the community. Curricula with newer modalities of teaching such as PBL may require additional resources, including increased numbers of faculty and
tutorial spaces to house small-group teaching. Consideration in curricular design must also be given to the increasing pressures on faculty regarding their clinical duties, teaching responsibilities, and research commitments; growing demands and higher student numbers at a time of financial constraints; as well as increasing requirements for transparency and accountability on the part of accrediting agencies as well as the general public.

In order to manage the increasing complexity of medical programs, Harden developed a number of recommendations, which can be equally applied to veterinary programs. These are outlined in Box 1.3. Of particular importance is the central management of the curriculum, which is also mandated in the accreditation standards of the AVMA COE.

### Curricular Review and Reform

As discussed in the introduction to this chapter, curricula in veterinary medicine must refocus on the fundamental skills required of all graduates and incorporate the principles of learning that will achieve these skills. Thus, most veterinary curricula in North America are presently undergoing review, followed by either modification of the existing curriculum, or redesign and implementation of a new curriculum. Irrespective of the path chosen, this process in an academic environment is not easy, as either path will involve change. Change in medical education has been described as neither enduring nor certain (Shuster and Reynolds, 1998) and the widely used phrase “reform without change” has represented the outcome of many medical education reform efforts (Matson et al., 2013).

Classically, review is defined as the act of carefully looking at or examining the quality or condition of something or someone, or a report that gives someone’s opinion about the quality of something. Reform is defined as the improvement of something by removing faults or problems. When applied to a curriculum, a review is usually an in-depth evaluation of either components of the curriculum or the curriculum as a whole, with the end result being to determine what is working well and what could be improved. Generally, reform is the process that is undertaken to correct problems, in the belief that there will be a positive change. Change can be considered as the transformation of an individual or a system from one state to another, a process that may be initiated by internal factors, external forces, or both.

A widespread barrier to reform of medical education is faculty resistance, often because faculty are more vested in maintaining the

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**Box 1.3: How to implement curricular management strategies**

- Ensure that responsibilities and resources for teaching are allocated at a college rather than departmental level.
- Develop a curriculum committee with faculty, staff, and student representation, which is responsible for planning and implementing the curriculum.
- Appoint a teaching dean or director of veterinary education who has a commitment to curriculum development and implementation.
- Appoint faculty with particular expertise in curriculum planning, teaching methods, and assessment to support work on the curriculum.
- Recognize the time and contributions of faculty to teaching and learning.
- Introduce a required faculty development program involving “teaching the teacher.”
- Allocate responsibility to an independent group for academic standards and quality assurance.

Source: After Harden (2013).
status quo than in launching educational reform (Bloom, 1989). The reported reasons include differences in priority for educational activities compared with research or patient care, as well as a desire to promote one’s academic specialty and department over school-wide educational goals. The literature supports the notion that efforts at educational innovation are also impeded by organizational structure (Cohen et al., 1994). Generally speaking, institutional structures and reward systems tend to support departmental and discipline-based boundaries, whereas many of the curricular innovations support school-wide, integrated curricula. Factors found to facilitate change in medical schools include centralized curricular governance, resources dedicated to education, and leadership committed to change (Cohen et al., 1994).

Reasons for Change

Educators often have both internal and external reasons for undertaking curricular review and reform. Internal reasons could include to improve the curriculum by aligning the delivery of information with current teaching methodologies or adult learning strategies; to determine the differences between the planned curriculum and the delivered curriculum; or as a component of curricular evaluation. External reasons could include calls for reform from within the profession; requirements of accrediting bodies; or as a result of information from stakeholders. In medical schools, proposed reforms have tended to suggest changes in manner of teaching, content of teaching, faculty development, and organizational structure (Christakis, 1995).

As described earlier in this chapter, the AVMA’s COE requires the curriculum as a whole to be reviewed at least every seven years (AVMA, 2014). It also states that “there must be sufficient flexibility in curricular planning and management to facilitate timely revisions in response to emerging issues and advancements in knowledge and technology” and “curricular evaluations should include gathering of sufficient qualitative and quantitative information to assure the curricular content provides current concepts and principles as well as instructional quality and effectiveness.” In the 1990s, the accrediting body for medical education in the United States strengthened its accreditation standards, resulting in improvements in medical education and curricular evaluation (Kassebaum, Cutler, and Eaglen, 1997). These standards, such as “institutions must develop a system of assessment which assures that students have acquired and can demonstrate on direct observation the core clinical skills and behaviors needed in subsequent medical training” (Kassebaum, Cutler, and Eaglen, 1997, p. 1132), are quite similar to those recently introduced into veterinary education.

Models of Change

The concept of change management is familiar to most organizations, and an understanding of the nature of change and change management is essential for today’s educational leaders. Many of the models of change reported in the literature have been applied to educational change. A few of the more common ones are mentioned in what follows.

Lewin’s Unfreeze–Change–Refreeze Model

A simple and easy-to-understand framework for managing change known as Unfreeze–Change–Refreeze was developed by Kurt Lewin in the 1950s. Lewin explained organizational change using the analogy of changing the shape of a block of ice; that is, unfreezing a large cube of ice to reform it into a cone of ice. These three distinct stages can be used to plan the implementation of a change. The first stage (unfreeze) involves creating the motivation to change. Irrespective of the model, communication about the proposed change is vital if people are to understand and support it. The second stage (change) occurs by promoting effective communication and empowering people to embrace new values, attitudes, and behaviors. In this stage, problems should be identified and solutions developed, with an outlook of flexibility rather than rigidity. The process ends when the organization returns
to a sense of stability (refreeze) and the benefits of the change are realized. The change must be incorporated into the culture for it to be frozen.

The Change Curve

The Change Curve is widely used in business and change management and is attributed to psychiatrist Elisabeth Kubler-Ross, from her work on personal transition in grief and bereavement (see Figure 1.2). All change involves loss at some level, so this model is a good way to understand people's reactions to change and its effect on performance. In reality, these stages are defense mechanisms, or coping mechanisms, through which people move in order to manage change; however, the movement is not linear, and people occupy different stages at different times, moving both forward and backward through the stages. The five stages are denial, anger, bargaining, depression, and acceptance. They can be illustrated by the Change Curve, which conveys levels of emotion, energy, impact, or performance.

In the first stage (shock and denial), people require time to adjust. Here communication is vital, so that they are provided with information in order to understand what is happening. In the next stage (anger, bargaining, and depression), people react to the change; this is the lowest point on the curve and it is common for morale to be low, anxiety levels to peak, and performance to fall. This stage needs careful planning, with consideration of impacts and objections as well as clear communication and support. The final stage (acceptance and integration) is the turning point for the organization: people accept that change is inevitable and begin to experiment with the change rather than working against it. It is here that faculty will try new educational methodologies or technologies and faculty development is important for success. Here the change becomes the norm.

Kotter’s Eight-Stage Process for Creating Major Change

Kotter’s eight-stage process for creating change (Kotter, 1996) has been applied to medical education. His eight stages are establishing a sense of urgency, creating a guiding coalition, developing a vision and strategy, communicating the change vision, empowering broad-based action, generating short-term wins, consolidating gains and producing more change, and anchoring new approaches in the culture. Details of how this approach was successfully applied to provide the framework for a major curricular reform are discussed in the next section.

Process for Curricular Change within Medical Schools

There are several reports in the medical literature that outline the processes and steps undertaken to achieve major curricular change successfully. One group of eight medical schools
collaborated on a foundation grant to bring about significant curricular change and wrote extensively about their efforts. They divided the process into three steps based on decisions, activities, events, and issues, and commented in detail on the important aspects of each step (Lindberg, 1998). For Step 1 (planning the innovation and creating the climate for change), all the schools agreed that it was exceedingly important to remain flexible and to provide ample time and opportunity for faculty members to assimilate and become more comfortable with the innovation. To ensure success, the schools agreed that they needed to develop participatory strategies and broad-based ownership before moving on to the next phase. For Step 2 (making the change), they reported that institutional change takes a long time and requires a lot of hard work. They found that commitment, patience, and perseverance were required, since resistance surfaced when the changes collided with faculty interests and departmental prerogative. Inclusion and shared ownership were the most effective tools. For Step 3 (maintaining the new order), they reported that successful implementation does not guarantee that the innovation will continue. They found that steadfast support from the leaders and committees that oversaw the reform was needed in order to maintain the faculty’s commitment to the innovation. They reported that the real challenge for them was to institutionalize the change process (Lindberg, 1998).

Major curricular change undertaken by another medical school was found to correlate well with Kotter’s eight-stage leadership model. The first phase of curricular change was to establish a need and foundation for change. Using task forces, the school established a new educational mission, a good understanding of its current curriculum, and the principles to guide the development of the new curriculum. The dean’s recognition and ongoing articulation of the need to change were the precursors to action and were heralded as a constant reminder of why change was necessary. The dean also recruited new leaders in education, and the role of the curriculum committee was revised to an action-oriented, policy-setting body. The second phase of curricular reform was to create a vision for a bold new curriculum; again, task forces provided recommendations for improvements through incremental change, as well envisioning a radically new and innovative curriculum. The third phase was to design the curriculum and obtain the necessary approvals, which required leaders to create task forces consisting of many faculty and students. In the fourth phase, specific courses were developed for the new curriculum, and at each step in the process they celebrated their successes and focused everyone on the road ahead. During the fifth phase of implementation and evaluation, leaders were required to address challenges, monitor the educational process and outcomes, and anchor the new approaches in the institution (Loeser, O’Sullivan, and Irby, 2007).

Lessons Learned

While a number of studies discuss what worked well and areas of challenge, one study systematically searched and synthesized the literature on educational curricular change, with the aim of providing guidance for those who direct curricular change initiatives in medical schools. In spite of the highly diverse literature reviewed, the authors reported a consistent set of characteristics that emerged as being associated with successful curricular change. They presented the results in a three-part organizational framework, as follows:

1) **Context**, which included characteristics present in the organization that facilitated change. Factors discussed in this cluster were mission and goals, history of change in the organization, politics, and organizational structure.

2) **Curriculum**, which included characteristics pertinent to the curriculum itself. Factors discussed were the need for change and the scope and complexity of the innovation.

3) **Process**, which included characteristics that relate to the process of implementing curricular change. Factors discussed were cooperative climate, participation by
organizational members, communication, human resource development, evaluation, performance dip, and leadership (Bland et al., 2000).

The characteristics that were found to affect the success of curricular change are discussed in detail in the article and provide good insight for those embarking on such change. With further analysis, the authors were able to distill this list down to six categories of features that predominated in the literature: leadership, cooperative climate, participation by organizational members, evaluation, human resource development, and politics. They commented on the strong influence of the leader(s) and the leadership approach to the success of curricular change. This occurred because the leaders controlled or substantially influenced nearly all the other features found essential for success. They also reported that articulating and advocating an organizational vision were essential to success.

Two other important points that influence curricular change are control of the budget and communication. Centralized control of the budget for education was found to be important not only for ensuring success, but also for supporting curricular innovation and advancing interdisciplinary approaches to the curriculum (Kaufman, 1998; Robins, White, and Fantone, 2000). Further, as central educational authority grew, the role of department chairs in controlling the educational program and resources weakened. Communication was also found to be a central and decisive element in the likelihood that change would be successful (Dannefer, Johnston, and Krackov, 1998; Loeser, O’Sullivan, and Irby, 2007; Gerrity and Mahaffy, 1998). Change produced uncertainty, brought into question accepted beliefs and practices, and increased the need for new shared meanings about how education should be organized (Dannefer, Johnston, and Karckov, 1998). These authors outlined the communication strategies needed to promote a sense of ownership among all participants, the structures and mechanisms for supporting positive communication, and the common lessons learned by all schools about successful communication.

A number of studies point out that while implementing curricular change is difficult, an even greater challenge presents itself in sustaining or institutionalizing the reform. Steadfast support from the leaders and committees that oversee the reform was needed to maintain the faculty’s commitment to the innovation (Lindberg, 1998). Continuing resources, faculty support, and an ongoing, systematic program of evaluation were also important in maintaining the innovation (Robins, White, and Fantone, 2000).

**Ongoing Evaluation: A Better Process**

Recent literature suggests that change, not stability, is the steady state. Thus, change should not be seen as a preplanned and predictable event, but rather as an open-ended, ongoing, and unpredictable process aimed at aligning and realigning in response to a changing environment (Lovato and Wall, 2014).

Based on this knowledge, a better process would be program evaluation. This is defined as “the systematic collection and analysis of information related to the design, implementation and outcomes of an education program, for the purpose of monitoring and improving the quality and effectiveness of the program” (ACGME, 2013). Inherent to this definition is that it is ongoing, designed for program improvement, and a component of outcomes assessment. This circular process is outlined in Figure 1.3.

In veterinary education, one of our faculty described this process: “you mean we should be a nimble little sail-boat tacking to make small directional changes to reach newly identified destinations rather than a large container ship heading off in one direction only to find that the destination has changed and that a large directional changes is needed to correct course.”

There are several good reviews that outline approaches to program evaluation for medical schools and that can be easily applied to veterinary schools (Frye and Hemmer, 2012;

Conclusion

Veterinary curricular design, revision, and reform are all complex processes requiring significant time, effort, and resources. All studies in medical education that discuss the design of new curricula, or reform of existing ones, report how difficult it is to accomplish. One such study reported: “it requires dedication, hard work, and the ability to recover when we inevitably falter. We also found that change represents a complex interaction among many elements and that individuals and chance play critical roles. Last, we learned to expect the unexpected: No matter what we anticipated, and how we prepared, we were continually surprised by the turn of events” (Krackov and Mennin, 1998, p. S3).

References


