Designing blended learning interventions for the 21st century student

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Eagleton S. Designing blended learning interventions for the 21st century student. Adv Physiol Educ 41: 203–211, 2017; doi:10.1152/advan.00149.2016.—The learning requirements of diverse groups of students in higher education challenge educators to design learning interventions that meet the need of 21st century students. A model was developed to assist lecturers, especially those that are new to the profession, to use a blended approach to design meaningful learning interventions for physiology. The aim of the model is to encourage methodical development of learning interventions, while the purpose is to provide conceptual and communication tools that can be used to develop appropriate operational learning interventions. A whole brain approach that encourages challenging the four quadrants is encouraged. The main arguments of the model are to first determine the learning task requirements, as these will inform the design and development of learning interventions to facilitate learning and the assessment thereof. Delivery of the content is based on a blended approach.

LEARNING REQUIREMENTS of diverse groups of students at institutions of higher education challenge those who are lecturing physiology to design meaningful learning interventions that meet the learning needs of students. Digital technologies have brought new dimensions to how we approach learning, teaching, collaboration, and communication in fundamental ways (17).

This proposed model for designing learning interventions for physiology has two main events: the first is to determine the learning task requirements, and then to design and develop suitable learning interventions. The aim of the model is to encourage the methodical development of these learning interventions; while the purpose is to provide conceptual and communication tools that can be used to visualize, direct, and manage processes to develop or select appropriate operational learning interventions for the 21st century student.

The paradigm shift in instructional design is to move from the step-by-step instruction which revolves around when and how students learn to what and whether students learn. The starting point is to have a clear picture of which physiological concepts are important for students to be able to do, and then to organize the learning interventions and assessment to ensure that this ultimately happens (48).

The main arguments of the model entitled “The Ds for Designing Learning Interventions” are first to determine the learning task requirements, as this will inform the design and development of the learning intervention to facilitate and evaluate the learning process on an ongoing basis.

The cognitive skills needed are the ability to think, which requires the development of logical and analytic skills, according to the levels of complexity as outlined by Bloom’s taxonomy (1). Anderson et al. (1) added context to Bloom’s taxonomy by distinguishing between levels of knowledge as being factual, referring to the basic elements students must know to be acquainted with a discipline to solve problems; conceptual, referring to the ability to identify interrelationships among basic elements within a larger structure that enable them to function together; and procedural, which includes how to do something, methods of inquiry, criteria for using skills and metacognition, and the awareness of one’s own cognition. Using the conduction system of the heart as an example: the students have to know the different structures that make up the internodal pathway; they then need to be able to relate each of these structures to its specific function and then relate it to its role in the contraction of the cardiac muscle to ensure that the overall function, the “pumping” of the blood through the heart, happens in the right sequence. Once they have mastered this, further intricacies can be added, and these events can be related to an ECG and the cardiac cycle.

Andersen et al. (1) combined these cognitive processes with the knowledge levels to form a matrix. In Table 1, one example for each category illustrates how the matrix can be used.

The affective domain refers to the way in which we deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes. The five major categories listed from the simplest behavior to the most complex are receiving and responding to phenomena, valuing a partic-
ular phenomenon, organizing values into priorities by contrasting different values, and internalizing values (27). Students need to be made aware of the application and importance of physiology in their future careers. This will encourage them to appreciate the importance of not only memorizing the subject, but also understanding it to be able to apply it.

The psychomotor domain refers to physical movement, coordination, and use of the motor skill areas. The development of these skills require practice and is outlined in Dave’s taxonomy (11). He uses the following levels, imitation, manipulation, precision, articulations, and naturalization, to illustrate the complexity of psychomotor activities. Laboratory sessions are where students get the opportunity to experience physiological processes and develop the skills to work with laboratory equipment. The PowerLab (PowerLab ADInstruments) systems provide a good starting point to develop basic psychomotor skills and an understanding of physiological processes.

The conative needs, according to Snow (46), refer to the will, desire, drive, level of effort, mental energy, intention, striving, and self-determination to perform at the highest standard possible. It is vital that students get to the point at which they have the internal desire to know and understand physiology. A blended learning approach can be used to create the environment for this.

Kolbe (25) compared the roles of the cognitive, affective, and conative domains in education. Table 2 is a summary of his comparison (39).

How to design a blended learning environment to incorporate these requirements will be elaborated on in the section Designing the Learning Interventions below.

Identifying prerequisites for a module. The construction of new knowledge depends on existing schemata into which new concepts can be assimilated. When learning interventions are designed, these need to be identified, and students need to be alerted to refresh their memories regarding specific concepts. The required knowledge could be from the same module or from supporting modules. Transfer of knowledge does not happen automatically for most people. This will require scaffolding, which can be reduced as students become more competent. The challenge is that deep learning comes from the ability to accommodate (transfer) new information into the existing schemata and then to be able to apply this in authentic situations (unpublished observations). An example of this is when transport of gasses across the respiratory membrane is explained, Dalton and Henry’s laws from physics need to be incorporated. These laws need to be related to gaseous exchange. Students also need to be reminded that the blood supply to the alveoli is deoxygenated blood to be exchanged for oxygenated blood leaving the alveoli. Integrating this information will help the student to understand the importance of the pressure gradients and solubility of gasses when a gas needs to dissolve in a fluid. Once they have mastered this concept, they can be asked to relate this to gaseous exchange at high altitudes and areas where the pressure is increased, such as during scuba diving.

Establishing the learning outcomes. The design of specific outcomes for a module have to be based on the exit level outcomes of the specific qualification. The expected outcomes for the module need to be benchmarked for the specific qualification and level of study. This approach is in line with the constructivist view that learning needs to “spiral up” from what is already known (26, 48).

The students need to be informed what they should be able to do and which values need to be instilled. The learning interventions should be planned to ensure that students are

### Table 1. The cognitive dimension

<table>
<thead>
<tr>
<th>The Knowledge Dimension</th>
<th>Remember</th>
<th>Understand</th>
<th>Apply</th>
<th>Analyze</th>
<th>Evaluate</th>
<th>Create</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factual</td>
<td>list</td>
<td>paraphrase</td>
<td>classify</td>
<td>outline</td>
<td>rank</td>
<td>categorize</td>
</tr>
<tr>
<td>Conceptual</td>
<td>recall</td>
<td>explains</td>
<td>show</td>
<td>contrast</td>
<td>criticize</td>
<td>modify</td>
</tr>
<tr>
<td>Procedural</td>
<td>reproduce</td>
<td>give an example</td>
<td>relate</td>
<td>identify</td>
<td>critiques</td>
<td>plan</td>
</tr>
<tr>
<td>Metacognitive</td>
<td>proper use</td>
<td>interpret</td>
<td>discover</td>
<td>infer</td>
<td>predict</td>
<td>actualize</td>
</tr>
</tbody>
</table>
equipped with knowledge, competence, and qualities needed for success in the various roles they will play once they qualify. The learning program should be structured in such a way that the outcomes can be achieved and maximized for all students (26).

Designing the Learning Interventions

In higher education, there is concern to improve students' achievements through focused well-planned learning interventions (21). These learning interventions need to cultivate whole brain learning, strengthening students' preferred modes of learning and helping them to develop the alternative modes of learning. The student profile can be used to inform these needs. The interrelationship of the concepts involved in the design of the learning interventions is summarized in Fig. 2.

When learning interventions are designed, the personality traits, information processing strategies, and teaching and learning strategies need to be taken into account. Personality traits that influence learning show correlations with cognitive strategies. A strong positive correlation has been shown for judging students to be sequential learners and to be left-brain dominant, while their perceiving peers tend to be global learners that are right-brain dominant (unpublished observations). This forms the inner circle of Fig. 2.

Designing learning interventions that take differences in information processing into account requires consideration of both how information is perceived, as well as how it is cognitively processed. These form the middle circle of Fig. 2.

Designing learning interventions to accommodate perceptual preference takes visual, auditory, and kinesthetic students into account. Visual students prefer diagrams and schematic representations of information. They can extract detail from background information. They understand better if they can see the body language of the lecturer. Visual students normally prefer to study in a quiet environment (56). Auditory students prefer verbal instruction in the form of a lecture or a discussion. They find it hard to study from notes only. They learn best when they discuss information or work in groups. Distinctions that are important to them include pitch, tempo, volume, rhythm, and resonance. They prefer to study in a noisy environment, as sounds can evoke memory of information (28, 55, 56). Kinesthetic students prefer to be involved in real-life experiences. They learn from external stimuli and movement. They are often risk takers and tend to be disorganized.

Table 2. Kolbe’s comparison of the cognitive, affective and conative domains

<table>
<thead>
<tr>
<th>Cognitive</th>
<th>Affective</th>
<th>Conative</th>
</tr>
</thead>
<tbody>
<tr>
<td>To know</td>
<td>To feel</td>
<td>To act</td>
</tr>
<tr>
<td>Thinking</td>
<td>Feeling</td>
<td>Willing</td>
</tr>
<tr>
<td>Thought</td>
<td>Emotion</td>
<td>Volition</td>
</tr>
<tr>
<td>Epistemology</td>
<td>Aesthetics</td>
<td>Ethics</td>
</tr>
<tr>
<td>Knowing</td>
<td>Caring</td>
<td>Doing</td>
</tr>
</tbody>
</table>

Fig. 2. Blended whole brain learning.
They use highlighters and pictures to study. They learn best when there is music in the background and snacks are available (55, 56).

The cognitive information processing strategies are used to organize and store perceived information. Information processing involves a cycle of events (24), as is illustrated in Fig. 3 (15).

A student can start learning at any point in the cycle, depending on his or her information processing preference. The learning cycle fits into the four quadrants of brain processing as described by Herrmann (22). Left-brain-dominant students are analytic and logical and should be challenged to approach new content by inquiry and critically thinking about new concepts. Their right-brain-dominant peers who prefer a more holistic approach should be challenged to think laterally and learn by solving problems about new concepts. Alternating these approaches will ultimately lead to whole brain development, as students will be using both their left and right brain strategies.

Environmental needs of the different groups of students will assist with planning the setting during learning interventions. The importance of considering environmental needs of students was elaborated on by Carbo et al. (5).

Environmental elements that influence learning include sound, light, temperature, and the design of the learning space. Students are either stimulated or inhibited by the environment in which they are trying to learn. Their reactions are determined by their biological makeup.

While some students need sound, either noise or music to learn, others need silence to be able to study. The light intensity has an effect on the ability to learn: while some students prefer bright light, others need dim light to optimize their learning. Heat perception also varies among people. Physical discomfort interferes with the ability to concentrate. Students differ in their ability to sit and study at a conventional desk, or study on a bed, lounge chair, a couch, or on the floor. Students squirming in their seats to try to find a comfortable position are often accused of fidgeting and urged to sit still. Student’s environmental needs are important to them and are beyond their control (5).

Developing and Delivering Learning Interventions

Lecturers all too often go into the classrooms to teach, assuming that all they need is expert knowledge of the discipline to be a competent lecturer. The time has come to practice evidence-based teaching (30). The challenge is to develop teaching and learning strategies using appropriate resources to encourage students to use all four quadrants of the brain to facilitate learning.

The mode of delivery refers to how the content will be presented to the students. When a module is designed, it is important to use a blended approach by incorporating as many different modes of delivery as possible to accommodate different teaching and learning strategies.

Higher education institutions realized that holding onto the past learning and teaching practices is not congruent with the needs of the 21st century student (52). There is increasing evidence that internet information and communication technologies are transforming much of society; they have an impact on the transformation of higher education (19). Blended learning has been introduced in tertiary institutions for more than a decade and has gained importance during the last 6 yr with the development of online learning. Terms that have been used interchangeably with blended learning are “mixed mode learning,” “hybrid instruction,” and “technology-mediated learning.” The understanding of blending learning is a combination of “face-to-face instruction and technology enhanced instruction” (53). Garrison and Vaughn (18) argue that blended learning is “the thoughtful fusion of face-to-face and online learning experiences” such that the strengths of each mode are blended into an optimal learning experience within a unified course (51). Blended learning combines the affordance of various digital technologies, such as social networking, virtual collaboration, and generating of online resources, with the real-life social interaction of face-to-face teaching (17).

It is imperative to ensure that each individual develops individually and collectively adds to a meaningful learning environment by delivering the right content to the right people at the right time (44). This implies that blended learning requires the intentional redesign of learning material with appropriate support structures, where the emphasis is shifted from assimilating information to constructing meaning and confirming understanding in a community of enquiry (19).

Creating a blended learning program is an evolutionary process that needs to take into account the capabilities of the lecturers, the infrastructure of the institution, and also the receptiveness of the learners to new learning formats. Initially, e-learning activities can be introduced as a supplement to the current offering. This can then be developed into a blended learning program (43).

The blended learning design can be integrated into the whole brain model for learning (15), as illustrated in Fig. 3.

Teaching strategies. A myriad of theories and models have been published to suggest improvements to teaching strategies. The emphasis shifted from behavioral theories to cognitive theories and currently mostly emphasizes constructivist teaching strategies. Recent research in instructional design also stresses the difference between learning interventions that lead to deep learning as opposed to superficial learning (4). These teaching theories are all important; however, they should be
used in combination to develop whole brain learning, as illustrated by Figs. 2 and 3 (15).

TEACHING STRATEGIES TO DEVELOP LOGICAL THINKING. Students use the logical quadrant of their brain to sense and experience information. A teaching strategy that can be used to support and develop logical thinking is inquiry. Inquiry involves more than asking questions; it requires of the student to get involved in seeking for information, which will enable constructing of new knowledge and understanding (16).

Inquiry-based learning is a discovery method of learning. Learning takes place most notably in situations where students draw on their own experience and prior knowledge to discover truths that are to be learned. Inquiry-oriented learning reflects the constructivist model of learning in that it states that learning is the result of ongoing changes in our mental framework as we attempt to make meaning of our experiences. In this active mode of learning, students are encouraged to make meaning by developing and restructuring knowledge schemes of concepts (unpublished observations).

In a blended learning environment, the information can be introduced in the form of a brief lecture, or reading of journal articles or a section from a book or website. This is followed by clearly defining the outcomes that need to be reached with the inquiry, by which means it needs to be done (define a problem question; gather data from different resources, printed or electronic; compare, organize, and analyze data, making use of electronic programs where applicable; create or support a proposition; or propose a solution), as well as how it needs to be reported. Students should not be left in the dark as to what is expected of them: they need to be provided with a supporting structure to focus their inquiry that does not limit their creativity (23).

Well-designed inquiry learning leads to authentic knowledge construction by working within the conceptual framework and “ground rules” of the specific discipline. The outcome of the inquiry goes beyond “what we know” about a concept. By aggressive questioning, it informs the students about how the concept is organized and how it relates to other concepts, as well as how to communicate the information effectively, thus helping them to become problem solvers (16).

In the classroom, the inquiry-based learning intervention needs to be initiated by engaging students in a conversation about what they already know about the concept. Alerting students to the link between what they already know and what is expected of them now will help them to identify gaps as well as misconceptions in their current knowledge and understanding of the concept. The students need to be given background on the topic of inquiry to enable them to perceive and formulate meaningful inquiries (14).

Inquiry-oriented learning calls students to investigations to satisfy curiosities. Students should be challenged to investigate a concept that was discussed during a lecture. Curiosities are satisfied when they construct mental frameworks that adequately explain their experiences. They should be challenged to seek application of the concept during this investigation. There is no authentic investigation or meaningful learning if there is no inquiring mind seeking an answer, solution, explanation, or decision. It is vital to make students aware that memorizing facts is not enough, they should be able to make meaning of a concept and be able to apply it in context. Students should be able to derive rules and theories as opposed to facts and systems. Students are encouraged to make meaning of what they are studying by individual investigation (unpublished observations).

TEACHING STRATEGIES TO DEVELOP ANALYTIC THINKING. Students need to be challenged to use the analytic quadrant of their brain to nurture and develop critical thinking skills. In the learning cycle, this quadrant of the brain is associated with reflecting and observing (14).

The strategy to developing critical thinking strategies is not to instruct students in critical thinking; instead, the strategies should be modeled by “the guide on the side” (50, 53), while the students take ownership of the direction of the investigation. Developing critical thinking strategies includes strategies that sharpen the focus on the concept and strategies that help students dig deeper into the concept (9).

Critical thinking strategies that sharpen the focus are used to make careful sense of a concept and clarify it to create common ground. Strategies that can be used are to identifying the direction, sorting out ideas for relevance, and focusing on key points to understand each of the underlying concepts. Critical thinking strategies assist students to realize the depth of the investigation includes full-spectrum questioning, making connections, and honoring multiple perspectives (9).

These critical thinking strategies can be used to find analogies and other relationships between concepts and to determine the relevance and validity of information used to solve the problem. The critical thinking strategies teach students to find solutions or alternative ways of treating problems. Teaching strategies that help to develop critical thinking are promoting interaction among students as they learn, asking open-ended questions (Why do you think that? Is it fact or opinion? How are these concepts alike? What would happen if?) and allowing time for reflection, and providing opportunities for the transfer of information to encourage the application of new information in authentic situations (37).

Through critical thinking, students organize their knowledge using visual representations of concepts to illustrate relationships by using tools such as concept maps and diagrams to ease the information overload on the working memory. An example is asking students to use a flow diagram to relate the role of the juxtaglomerular apparatus of the kidney to the regulation of blood pressure. They need to be able to relate each “step” in the flow diagram to the physiological concept supporting it. It is imperative to remember to build on what is already known and to recognize similarities between new information and what they already know by using advanced organizers such as rules, analogies, or concrete instances. Deep thinking can be facilitated through elaboration using cooperative learning strategies, such as peer tutoring and paired problem solving, to make students observe and modify their own thinking processes (unpublished observations).

TEACHING STRATEGIES TO DEVELOP HOLISTIC THINKING. Thinking is a skill that needs to be taught to students to help them meet the needs of current challenges in the real world (2). Thinking determines how intelligence is used (42). Lateral thinking is free of constraints and is concerned with changing preconceived notions to bring out new ideas. Techniques associated with lateral thinking are challenging existing notions and looking for alternatives and provocations, where the situation is first imagined and then plausible solutions need to be sought (42). Edward de Bono, who coined the term lateral
thinking, developed a tool that encourages people to make decisions only once all points of view have been considered. This is done by analyzing the problem from different directions using unorthodox methods, which would normally have been ignored (2, 42).

Lateral thinking is concerned with changing concepts and perceptions. Lateral thinking is about reasoning that is not immediately obvious and ideas that may not be obtainable by using only traditional step-by-step logic. Lateral thinking refers to the generation of novel solutions to problems. Many problems require a different perspective to solve them successfully. Lateral thinking applies to problem solving, breaking up the elements of a problem and recombining them in a different way. Lateral thinking is distinguished from critical thinking in that critical thinking is concerned with judging the truth value of statements and seeking errors, while lateral thinking is more concerned with the movement value of statements and ideas, creating new ideas (unpublished observations).

This level of thinking would be more applicable to more advanced students involved in research projects, where they need to learn to build on what is already known to formulate and defend their own “new” findings.

TEACHING STRATEGIES TO DEVELOP EMOTIVE THINKING. Problem-based learning can be used to get students practically involved in learning. Involvement will affect their attitude toward learning, as it requires a personal response. Problem-based learning can be distinguished from other forms of enquiry-based learning in that the problem is presented to the students before other curriculum inputs, making the student responsible for searching for appropriate sources of information. The learning comes from working toward the understanding of the resolution of a problem, rather than trying to memorize a rapidly changing knowledge base. This does not exclude other teaching strategies, such as lectures, practical sessions, and tutorials, which follow once the students have been presented with the problem to assist the students to use all the information to “solve” the initial problem (3, 41).

The rationale behind problem-based learning as a teaching strategy is to challenge the students with ill-structured, open-ended, real-life problems that stimulate critical and creative thinking, develop problem-solving skills, and stimulate self-directed learning strategies and team participation skills (3). Through problem-based learning, students are empowered to conduct research, integrate theory and practice, and develop the skills to solve a defined problem (41).

Problem-based learning can initially be scaffolded to reduce the cognitive load by guiding the students through the steps they will have to follow to solve a typical problem. This guidance fades when students gain experience in the process of problem solving (3).

According to Barrett (3), these steps involve clarifying the terms and concepts used in the problem description and then identifying the phenomena that need to be explained, after which prior knowledge and common sense are used to brainstorm the phenomena concerned. The next step is to criticize the proposed explanations and to formulate learning issues to “fill the gaps” in their current knowledge. This is followed by gathering the information required to address the problem through self-directed learning, where individuals take the responsibility for seeking relevant information to be able to share multiple perspectives in the collaborative group to reanalyze the problem and formulate a comprehensive answer to the problem. These steps help the students to coelaborate and coconstruct their knowledge, which in turn leads to “social and cognitive congruence.” Case studies can be used for problem-based learning.

The epistemological position in problem-based learning is to see knowledge not as something static, but rather as something that is made and remade through dialogue, which is in line with postmodern concepts of knowledge (3). Problem-based learning further promotes multidisciplinary student-centered learning, stimulating lifelong learning (41).

“One of the best ways to prepare future employees is to teach students how to think not what to think.” (6)

Learning strategies. The importance of the appropriate learning strategies to process new information should not be underestimated. The students are not always aware of which strategy to follow to learn new concepts and should be guided in this respect. Developmental and individual characteristics that have a bearing on how students learn under specific conditions should be taken into account (40).

Students are more likely to learn when they learn with others than when they learn alone. There are different approaches to facilitate activities where students learn together, such as cooperative learning, collaborative learning, peer learning, and problem-based learning. The key to success when students are working together is that they should talk to one another, articulate their understanding of the subject matter, and ask and answer questions (30).

Meaningful learning is facilitated by articulating explanations, whether to one’s self, peers, or the lecturer. It is a common belief that a central part of learning any discipline is learning the language of the discipline. Learning a “new language” requires practice by reading and speaking that language. It is also true that articulating self-explanations improves meaningful learning and retention (30).

Specific learning strategies that students can follow are SQ4R (survey, question, read, record, recite, review) (49), which will not only help with remembering information but also improve understanding it. Acronyms (34), acrostics (12), songs, and rhymes (32) can be used to remember information, but also to link related concepts. Concept (35) and mind maps (29) can help with chunking and relating information (31).

Assessment. To keep in pace the changes that come with blended learning, educators need to design assessments to determine whether deeper learning of 21st century skills has been mastered. The assessments should also address the different cognitive strategies: logical, analytic, entrepreneurial (holistic), and problem-solving. The assessment should encourage the students not only to rely on rote learning information, but to ensure that they can analyze, synthesize, and apply what they have learned.

This cannot be accomplished by a single type of assessment. For assessments that fully evaluate deeper learning, the Stanford Center for the Opportunity Policy in Education (10) suggests five major features for quality assessment:

- Assessment of higher-order cognitive skills. There should be a balance between assessment of basic knowledge (recall, recognize, and implementation of procedures) and higher order cognitive skills using all four quadrants of the brains for activities such as analysis, evaluation, and production of
ideas, which calls for transfer of knowledge. The percentage of questions from basic and higher order skills will vary for first year and more senior students, starting at a 50:50 ratio and then decreasing the percentage of the basic questions. Bloom’s taxonomy can be used to distinguish between the different levels of cognition required to answer the questions.

- High-fidelity assessment of critical abilities. Assessment goes beyond summative evaluations, which traditionally are written tests. Summative assessment has often been associated with surface learning, as it tends to assess declarative knowledge and basic application with little or no evidence of personal reflection and deep understanding (45). These limitations of summative assessment have necessitated the integration of formative assessment using activities such as assessing students’ ability to gather relevant information from multiple sources (text, experiments, and simulations), which gives an indication of their ability to integrate and synthesize information (20). Authentic formative assessment activities motivate students to engage in decision making and problem solving and encourages metacognitive thinking and self-learning, which promotes engagement and transfer of knowledge to new situations as students are actively engaged in the assessment process. Formative assessment relates to multidimensional approaches to provide opportunities for alternative approaches, leading to different sources of evidence. This is enhanced by prompt feedback. If the formative assessment is online, the possibilities of feedback are enhanced and could include leading questions and hints; encouraging reflection, which has a beneficial impact on learning; and motivation and engagement of students who regularly engage with online assessments (54). Tailored feedback can promote self-regulated learning and encourage reflection to develop understanding. Formative assessment can be used to identify strengths and weaknesses to take remedial action until the desired level of knowledge is reached (7). Ongoing authentic assessment helps to facilitate and sustain multifaceted interactivity with content and learning tools and self-reflectivity, as proposed for a blended learning environment (20). Students’ ability to present the information either in written format or orally also forms part of evaluation. Assessments can also include evaluation of group tasks, as being able to collaborate with peers in an assignment is one of the more important 21st century skills that students need to acquire. Students can be involved in peer assessments from which not only do they have the benefit of receiving feedback, but they also learn how to give feedback to others (38).

- Standards that are internationally benchmarked. Assessment “standards” should be benchmarked with similar programs. Current skills that are ranked as the top attributes sought by companies are teamwork, problem solving, interpersonal skills, oral communication, listening skills, creative thinking, leadership, goal setting/motivation, and writing. Thus it is important for assessment systems to include these abilities when assessments are planned.

- Use of items that are instructionally sensitive and educationally valuable. It is important that assessment tasks should represent the curriculum content in ways that respond to the instruction, and in ways that inform the teaching.

- Assessments that are valid, reliable, and fair. Thus an assessment should be a good representation of the knowledge and skills it sets out to measure.

Preparing assessments with a clear sense of what needs to be assessed informs the selection of an appropriate assessment regime for the module.

Concluding remarks on benefits of blended learning. According to Porter et al. (36), the advantage of improved student interest and learning provided during blended learning over traditional teaching outweighs the barriers of heavy workload on staff and lack of financial support from management. Blended learning provides various benefits over using any single-learning delivery medium alone (43). Blended learning helps to balance the lack of flexibility of face-to-face classroom activities with the flexibility of online activities, while still allowing for interaction with peers and facilitators (32). It is, however, important to note that simply turning classroom courses into blended formats does not necessarily provided students with improved learning experiences. Careful analysis of the preference of the learners regarding communication (asynchronous and synchronous), their abilities and expectations, and the context and availability of technology need to be taken into consideration (12, 46).

Evaluation of the Process

When a course is implemented, it is not the end of the process. During the evaluation phase, the instructional designer measures if the goals for the module were achieved. The following questions can be asked to measure this:

- Did the students like the module? This can be done by asking the students to complete a short survey on completion of the module.
- How well did the students achieve the objectives at the end of the module? A pretest and a posttest can be used to measure this achievement.
- What specific strategies worked and what didn’t? Self-reflection during the module and once assessments have been completed will help to identify these strategies.
- Were there any behavioral changes as a result of the module? This is more difficult to measure and might take longer periods of time. A follow-up assessment might be necessary.
- How can I improve on the design of the process to help student learning? Self-reflection during the module and once assessments have been completed will help to identify strategies to improve student learning.

Evaluation is concerned with gathering information during all of the stages of the development of the intervention. This formative evaluation focuses on evaluating whether all the steps unfold according to plan, uncovering any obstacles and planning adjustments and corrections. Feedback gathered during formative evaluation is used to fine-tune the implementation of the module in the future.

Concluding Remarks

Facilitating learning in the 21st century is a challenge. The requirements to satisfy the needs of current students necessitates the change to a blended approach, making use of all of the possible media, while keeping in mind that “... the media are
mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries cause change in nutrition . . . only the content of the vehicle can influence achievement.” (8).

Suggestions for Future Studies

The model can be tested at physiology departments at different higher education institutions, and the outcomes evaluated and compared.

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SE analyzed data, prepared figures, drafted manuscript, edited and revised manuscript, and approved final version of manuscript.

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