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Curriculum Integration = Course Disintegration: What Does This Mean for Anatomy?

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Many basic scientists including anatomists are currently involved in decisions related to revisions of the undergraduate medical curriculum. Integration is a common theme in many of these decisions. As described by Harden, integration can occur along a multistep continuum from independent, discipline-based courses to a completely interdisciplinary curriculum. For anatomy, each derivative of curricular integration can be shown to involve progressive disruptions of the temporal and topographical relationship between organ systems in a body region, of the temporal relationship with other courses in a harmonized curriculum, and of the relationships between components of organ systems when integration is implemented in thematic curricula. Drawing from our experience teaching in various types of integrated medical curricula, we encourage readers to proceed cautiously with their curricular decisions because each one can have gains and losses that may impact learning in the new format. Anat Sci Educ 6: 205–208. © 2012 American Association of Anatomists.

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INTRODUCTION

Medical education is going through transition necessitated by the overwhelming progress in the discovery of new information about human biology, medicine, disease, and therapy. This has in turn spurred many creative ideas about how to handle the teaching and learning of the rapidly accumulating biomedical knowledge during the initial time available for initial medical training. One thrust has been toward curricular integration.

Integration is a current trend in medical education and has been for at least a decade (Dahle et al., 2002; Vidic and Weitlauf, 2002; Muller et al., 2008), although the desire to see it happen has a longer history (Ludmerer, 1999; Goldman and Schroth, 2012). Integration has its supporters and its critics. Recently, Goldman and Schroth (2012) proposed a framework that enhances decisions about integration at multiple levels of the curriculum, e.g., program, course, and course session. They caution that integration is a strategy for accomplishing goals of a curriculum rather than a goal unto itself.

The rationale often given for integration of the basic sciences and clinical medicine is, this is the way a clinician must think when they encounter a patient. But what is the best way to develop that kind of integrative thinking? What skills are necessary to effectively integrate science and clinical medicine? Are these skills intuitive or must they be learned? Do students entering a health professional school have the skills needed to effectively integrate multiple subjects? Is it possible for students to integrate basic science with clinical disciplines before they have a complete understanding of the normal functioning of the human body?

PERSONAL EXPERIENCES

In our experiences in medical education, and for some of us, in clinical practice, we have encountered situations that provide at least partial answers to some of these questions. One of us (D.L.B.) has recently participated in a curriculum

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organized into system-based modules that were multidisciplinary with respect to basic science and clinical medicine. I entered this experience thinking integration from the start of medical training made perfect sense. However, I discovered that integration of science and clinical medicine is a skill that is not intuitive to many students but needs to be learned and developed. Many of these first year students had difficulty seeing how concepts from several science disciplines fit together. The questions they asked suggested that they did not have a clear understanding of fundamental principles for some of the basic science disciplines that they were attempting to integrate. Although the semester began with a general principles unit where the foundations of the basic science disciplines were to be presented, there was insufficient time to provide them with the background they needed for integration. This agrees with the results seen by Van der Veken et al. (2009) who reported a steeper learning curve for students in an integrated curriculum as compared to a traditional curriculum. Another one of us (R.F.L.) recently participated in a curriculum revision where only the basic sciences were integrated during the first-year, followed by an integrated approach to the clinical sciences in the second-year. This is one way to reduce the slope of this learning curve. When reflecting on our own education, those of us with clinical training and experience (R.E., D.P.J.) did not develop meaningful integrative thinking until we began seeing patients. Because we had acquired a foundational knowledge base with respect to basic science concepts, we were able with the help of clinical mentors to see how to put these together to diagnose and treat our patients.

THOUGHTS DRAWN FROM OUR COLLECTIVE EXPERIENCES

Building a base of foundational knowledge about the basic sciences could perhaps be called pre-integration. Once this base is established, the knowledge can then be utilized and applied toward problem-solving and critical thinking (Brynhildsen et al., 2002). When should pre-integration begin? Traditionally this has been done in the first two years of medical school by means of discipline-based courses. How much should occur at the undergraduate level and how much within the medical curriculum? There is very little literature on this but Dahle et al. (2002) contend that it is important for students to acquire and revisit basic science knowledge in order to integrate and interpret clinical data from history, physical examination, and laboratory results. They also argue that basic science should constitute at least 20% of the clinical curriculum. The Flexner Report was the first to describe rigid premedical training in the sciences (Flexner, 1910). Subsequently, medical education has stressed a broad liberal arts and humanities education in the premedical curriculum with the basic medical sciences education being confined to the student's medical education (Chambers et al., 2011). Another argument is that premedical education should return to a heavy emphasis on the science and mathematics most relevant to human biology, with an emphasis on critical thinking and problem solving (Dienstag, 2008). More recently, one school has developed an integrated premedical/medical curriculum, where students begin enrolling in basic medical science courses as part of their premedical curriculum leaving the four years of medical training to be devoted primarily to the clinical sciences (Chambers et al., 2011).

Each traditional basic science discipline in the medical curriculum is intrinsically, horizontally integrated because prior information is successively required in order to effectively learn new material; in other words, the traditional ordering of many basic science subjects in the medical curriculum already demonstrates a striking similarity of cohesion that may be described as intra-disciplinary integration of content. If traditional disciplines already show an intrinsic horizontal organization of content, this means extra-disciplinary (interdisciplinary, multi-disciplinary) integration is the only form of curricular re-organization possible: the arrangement and delivery of connected relationships between disciplines. Similar to anatomical structures, integration as it relates to medical curriculum has many variations. There are multidisciplinary courses, interdisciplinary courses, courses arranged in tandem so that certain topics are covered at the same time, courses that may run in parallel to a separate integrating activity and fully integrated multidisciplinary courses (Fig. 1). Because of its regional approach, human anatomy is somewhat of a challenge to integrate with more systems-based courses like physiology and pathology. However, at one school anatomy was used as the foundation for the integration of the remaining basic sciences (Klement et al., 2011).

INTEGRATION STRATEGIES

Figure 1 illustrates schematically three different arrangements of courses, with a progressive unraveling of the associated temporal sequences that accompany delivery of disciplinary courses. In most traditional curricula, components of individual courses are linked/united by a sequencing pattern that builds learning and understanding over time. So, for example material in course A (Fig. 1, left panel) is presented in the sequence 1-2-3-4 rather than 4-3-2-1. In a gross anatomy course schedule, learning the concept of peritoneum would precede study of the stomach and small intestine. Assessment of learning and understanding (Fig. 1, left panel, examination box) is modeled correspondingly: components of a course are tested in a collective/integrated manner, i.e., component integration within a discipline. In our opinion, the merits of this curricular arrangement include: (a) the discipline is intact and (b) courses can be harmonized in a schedule so that they deal concurrently with a given part of the body, promoting some horizontal integration of knowledge across courses (Dahle et al., 2002).

Interdisciplinary bundles of components can be constructed and arranged over time if course components are aligned on the basis of other common criteria such as organ systems (Fig. 1, middle panel). With this arrangement in many medical schools (Dienstag, 2011), the temporal sequence is not critical because the basis is an integrated, functionally independent organ system. This model interferes with the relationship between components in each course, course identities are subsumed within organ system identities, and this is evident during examinations (Fig. 1, middle panel, examination boxes). Testing in this model evaluates understanding of the discipline-integrated workings of organ systems (interdisciplinary integration). Implementation of this model is more complex than with disciplinary courses, and in anatomy relationships between organ systems in the body receive reduced emphasis.

Disciplinary and organ system identities are both lost in a third model of integration (Fig. 1, right panel) when content

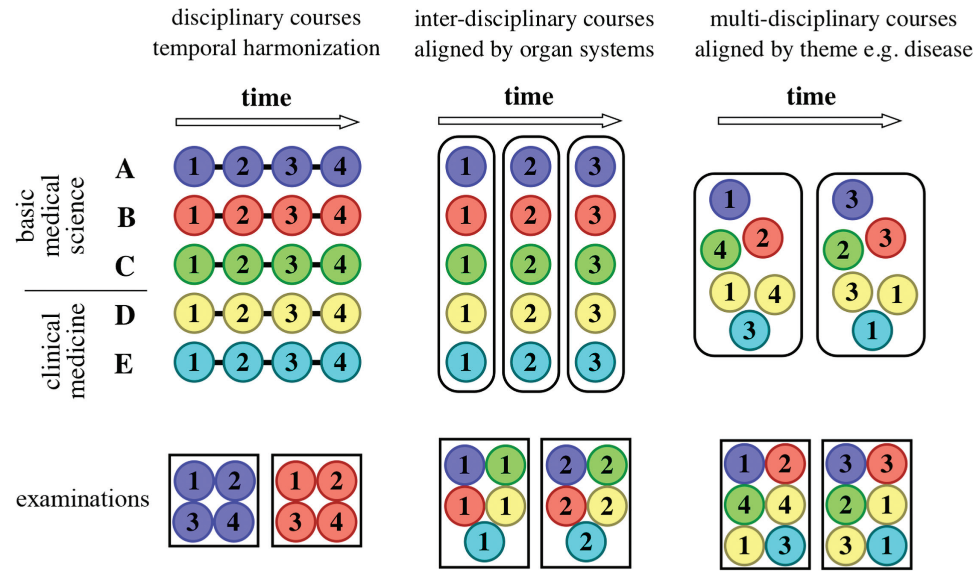

Figure 1.

Curricular integration = course disintegration. Each circle represents elements in a discipline; numbered circles depict sequential integration within the discipline. Assessment strategies are influenced by the curricular design; each box represents an examination.

is organized around themes, e.g., disease (stroke, renal failure). Harmonic relationships between courses or between disciplines in organ systems are diminished in this model that encourages learners to acquire and apply knowledge in the manner that would be encountered in clinical practice. Thematic assessments (Fig. 1, right panel, examination boxes,) test vertical integration of knowledge from various courses and organ systems, a model of disciplinary disintegration that in our opinion requires prior acquisition of foundational knowledge so that problem-solving and critical thinking skills can be applied toward understanding and managing disease (Brynhildsen et al., 2002; Dienstag, 2011).

A useful explanation of the variation in integration strategies is Harden's "integration ladder" (Harden, 2000). Can discipline-based courses and integration coexist? According to Harden's scheme, the further you climb the integration ladder, the more you achieve course disintegration (Harden, 2000). Careful planning is required to determine which of these integration strategies will best fulfill the goals of a medical curriculum (Goldman and Schroth, 2012). Without it, and perhaps even with it, changing integration strategies during curriculum remodeling can result in losses that may outweigh the gains. Subjects that were taught in tandem during the older version of a curriculum may now be completely separated in the newer version. As a result, correlations drawn or principles reinforced by the former arrangement are no longer possible. In fact there could now be large gaps in what was formerly a logical progression of knowledge. While the new strategy may create different opportunities for integration among subjects, it must be determined if the gains offset the losses.

Our experience suggests that merely integrating the curriculum does not automatically create students who can effectively integrate science and clinical medicine. Faculty can guide the process by giving examples of how to integrate the material, but when the actual integrating has to be accomplished, the students must do it themselves (Goldman and Schroth, 2012). It is well known that assessment is a motivating force for students (Wormald et al., 2009). If examination items are multidisciplinary or necessitate elementary clinical reasoning for integrating information from among multiple disciplines, then students might be motivated to practice integrative thinking. Others suggest that active learning strategies like problem-based learning may encourage students toward integrative thinking (Brynhildsen et al., 2002; Dahle et al., 2002). Dubois and Frankson (2009) suggest that e-learning approaches may enhance integrative thinking.

CONCLUSIONS

Our experience suggests that integration is complicated, that getting it right requires careful thinking and the establishment of clear curricular goals, that it can occur while maintaining discipline-based courses and as with any new strategy used, one must determine the gains and losses with respect to the former strategy.

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