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A Student-Led Methodology for Evaluating Curricular Redundancy

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Background: Curricular redundancy can be a significant problem for any educational curriculum. Redundancy can be both desirable and undesirable, but differentiating the two can be quite challenging. Further, pinpointing undesirable redundancy and quantifying it so as to produce an estimate of inefficiency is even more difficult.

Purpose: The purpose of this article is to describe a student-led strategy for evaluating redundancy in a highly integrated medical school curriculum. It is our hope that the methodology presented here will serve as a useful evaluation model for persons attempting similar work in various educational arenas.

Setting: A highly-integrated medical school at a large public university.

Intervention: This research did not require an intervention.

Research Design: We identified two advanced medical students and asked them to identify redundant material across the first two years of the medical school curriculum. The students had to operationalize 'redundancy', develop an evaluation plan/framework, and evaluate the extent to which undesirable redundancy was prevalent in the current curriculum.

Data Collection and Analysis: Students reviewed course syllabi, notes, and materials and documented the amount of redundant material they found in the curriculum.

Findings: A total of approximately 167 hours, or 8.35 weeks, could be eliminated from the curriculum; the vast majority of the redundancy occurred as a result of small group activities.

Keywords: *curricular redundancy; curriculum evaluation; student-led evaluation; medical education; participatory evaluation*

Introduction

Most educational curricula undergo a curriculum mapping process. While there is often a great deal of variation as to how curriculum mapping is performed, generally, the process involves identifying what is taught, how it is taught, when it is taught, and the measures used to determine whether student learning outcomes were achieved (Harden, 2001). One significant facet of most curricular mapping efforts is the identification of redundant material. Redundancy can be both desirable and undesirable. For instance, redundancy can be useful when attempting it involves building on previously taught concepts, or exposing students to information that they were likely taught some time ago. However, redundancy can be problematic when it occurs due to lack of communication among instructors or programmatic course offerings that focus on similar or related content. Non-useful redundancy can result in the loss of valuable instructional time, a narrowed curriculum, and limited opportunities for student learning.

Unfortunately, evaluating redundancy in a curriculum and discerning useful redundancy from non-useful redundancy can be quite challenging. Further, pinpointing undesirable redundancy and quantifying it so as to produce an estimate of inefficiency is even more difficult. Thus, the purpose of this article is to describe a student-led strategy for evaluating redundancy in a highly integrated medical school curriculum. It is our hope that the methodology presented here will serve as a useful evaluation model for persons attempting similar work in various educational arenas.

Review of Literature

Despite the existence of a considerable literature on curriculum mapping, the literature on curricular redundancy, in particular, is quite sparse. While many articles focusing on curriculum mapping acknowledge 'gaps' and 'overlaps' within a curriculum, few offer much more detail. Most searches for the term 'redundancy' in the educational literature yield citations for redundancy within the context of cognitive psychology and individual learning behaviors. Despite the fact that these works focus on redundancy at the micro level, there are some interesting considerations when extended to a macro curricular level.

Ornstein and Hunkins (1993) discuss the notion of vertical and horizontal integration within a curriculum. In short, vertical integration refers to course sequencing that allows for longitudinal learning, whereas horizontal integration refers to linking information across topics that are presented in a relatively simultaneous manner. Under both circumstances redundancy is likely to occur, but the nature of the redundancy is different. For instance, some disciplines such as music (Stambaugh, 2011) and language arts (Lam & Dijkstra, 2010) might greatly benefit from a plethora of courses that emphasize redundant information and repetitive behaviors within each particular course. However, when considering multiple courses that constitute the larger curriculum it may be disadvantageous to offer two or more courses that offer redundancy of content. Conversely, redundancy across the curriculum could be desirable in highly abstract and theoretical disciplines such as philosophy or theology where competing paradigms and perspectives are largely guided based on central works and perspectives.

One key consideration ought to be the amount of time that has passed since students were last exposed to particular content. Certainly, there are strengths and weaknesses of various intervals in time. For example, one might argue that vertical redundancy would be more advantageous than horizontal redundancy within the context of remediation. However, horizontal redundancy may be more advantageous than vertical redundancy within the context of knowledge saturation and expertise development.

Mayer (2001) discussed the 'redundancy principle', noting learning is generally improved when fewer repeated materials are included. This notion is particularly important as it pertains to instructors' presentation of material. Mayer contends extraneous mental effort is involved when learning involves multiple senses.(For instance, the combination of graphics, narration, and text might overwhelm students' cognitive capacities. Similarly, Mayer and Johnson (2008) discuss 'concise redundancy', a revised form of redundant text, as a more pedagogically effective strategy than rehashing full-text work. While these principles are discussed by the authors within the context of intimate, real-time learning, they do have some implications for curricular evaluation at the macro level. In particular, what happens in one classroom may have additional effects on student learning in other classrooms.

Because the courses in any given curriculum share some inexorable link, it is imperative that instructors communicate to other instructors information regarding the breadth and depth of content they plan to teach. When an instructor

learns s/he is teaching similar content to someone else, all relevant instructors should then communicate more about both the nature of the content and the manner in which the content is conveyed. Hanson (1992) points out that redundancy by way of different examples or different presentation of material can be effective. However, such opportunities to reinforce learning in a desirable way will likely not be exposed without good communication among instructors.

Literature searches uncovered two specific articles devoted to investigating curricular redundancy. In the first, Bernstein (1996) discussed its benefits within a law school curriculum. She notes law school curricula are "full of revisits" and claims the educational benefits of this are indisputable. Bernstein says "common ground emerges when students hear the same concepts in different classrooms" and goes on to say "redundancy is integral to legal education, not least because it distinguishes what is central from what is marginal" (pp. 217-218).

In the second article, Dalton and Wright (2004) investigated graduate social work students' perceptions of curricular redundancy. The authors of this qualitative study found most students enrolled in a Master of Social Work program viewed redundancies across the curriculum as generally positive, and helpful. While the study was limited to students' perceptions within the field, more studies of this nature would be helpful. After all, students of the curriculum are the primary consumers, thus it is critically important to understand their perspectives of the curricular product.

Review of Literature

Evaluation Framework

Most evaluations of curricular redundancy are intuitively conducted by faculty. Typically, the process involves reviewing course syllabi and identifying various elements of the curriculum. When possible, those responsible for teaching a course will engage in dialogue about the breadth and depth of their respective presentations of content. While this approach offers a great deal of utility it lacks a critical element: the expertise of the consumers. Advanced students within a program, namely upper-classmen, will have far greater insights about the nuts-and-bolts of the educational curriculum than anyone. These students have virtually a full and unobstructed view of the entire curriculum (with exception to some electives) and devote significant time each day to learning and retaining the content presented. We believe including students in the evaluation process is absolutely critical in yielding the most valid findings possible.

With regard to formal evaluation models, our methodology would most likely be considered participatory evaluation. Cousins and Whitmore (1998) state participatory evaluation "implies that, when doing an evaluation, researchers, facilitators, or professional evaluators collaborate in some way with individuals, groups, or communities who have a decided stake in the program, development project, or other entity being evaluated" (p. 5).

Scriven's Logic of Evaluation

In general, we attempted to follow Scriven's (1980) logic of evaluation to frame the evaluation. Scriven's logic consists of four primary points: (1) establishing criteria; (2) constructing standards; (3) measuring performance and comparing with standards; and (4) synthesizing and integrating information into a judgment of merit or worth. Using this framework, the criteria of merit in this evaluation are the sources of redundancies. The standards we opted to use are somewhat subjective as we relied on the unique insights of students to make informed judgments about redundancy. Measurement involved producing estimates of time attributed to redundant material, as determined by student evaluators. Synthesis involved a presentation of student evaluators' findings before the School of Medicine Curriculum Committee in which the findings were discussed with faculty and collaborative judgments were made as to where opportunities to cut redundancies could reasonably be made.

Evaluation Methodology

Student Evaluators. During the fall 2012 semester, two advanced medical students were invited to evaluate redundancy across the first two years of the University of North Carolina School of Medicine (Chapel Hill, NC) medical school curriculum. The students were selected based on their leadership roles as student representatives, willingness to help faculty and future students, and participation as consumers who had recently experienced the preclinical part of the curriculum. Also of note, the students were planning to participate in an MPH program after their third year, and were able to complete their review of the curriculum during a time when they did not have the responsibilities associated with the clinical curriculum. The students were offered a small

stipend for their work and asked to prepare a white paper of their findings and provide a presentation before faculty and administrators attending a curriculum committee meeting.

Developing a Framework for Executing the Evaluation. Student evaluators used the USMLE Step 1 Content Outlines to create a catalog of the content currently delivered in the UNC School of Medicine curriculum (USMLE, 2012). This framework was selected because this content outline was a comprehensive listing of the minimum content expected to be covered in any preclinical curriculum. It should be noted that the intention was not to limit preclinical instruction only to the material which is covered in Step 1.

Operationalizing "Redundancy". Student evaluators judged content to be *redundant* if more than one lecture or small group covered virtually identical material. Content was judged as *excessively detailed* if material was taught that was beyond the depth needed for both taking Step 1 and the start of the third year of medical school. The qualitative distinction between these two terms is important, as both indicate a variation of curricular redundancy.

Analytical Strategy and Documentation. In order to map the preclinical curriculum, the student evaluators first divided the number of courses in half and began reviewing syllabi, course lecture notes, and other artifacts from each of the courses. The evaluators documented the main topics covered in each of the lectures and small groups on the content outline while also noting instances where the content seemed too detailed. Evaluators then jointly reviewed the completed documentation to look for potential redundancies and revisited relevant lectures and small groups to judge (a) whether a true redundancy existed and (b) if so, whether or not this redundancy was appropriate.

Quantifying Redundancy. While reviewing the curriculum, evaluators attempted to quantify the amount of course time spent covering material. In general, lectures lasted about one hour, while small groups varied from one to two and one-half hours in length. Course durations were matched to the School of Medicine's learning management system for each lecture and small group, thus making each time unit as accurate as possible. Evaluators also used the time spent covering material to estimate how much instructional time would be saved by eliminating redundancies. On average, students currently experience approximately five hours of instruction time per day, five days per week. Foundational courses span four (8:00 AM - 12:00 PM) hours daily, with special courses in Clinical Skills Development (CSD), Clinical Skills Integration (CSI), and Clinical Epidemiology offered in the afternoons. Because the CSD, CSI, and Clinical Epidemiology courses do not correspond to the USMLE Step 1 content outline, they were excluded from the calculations of instructional time per day. Further, assessment and examination time were not factored into time calculations.

Evaluation Results. For purposes of clarity, student evaluators divided results into three different categories: (1) redundancy between the first and second year curriculum (vertical); (2) redundancy within each year (horizontal); and (3) material that was excessively detailed, thus resulting in another form of redundancy. While the details of the report were quite extensive and beyond the scope of this article, only pertinent, general comments with occasional specifics are presented below.

Redundancy across the First Two Years. The findings in this category represent material that was taught in the first year and then subsequently re-taught or reviewed in the second year (vertically redundant). A large portion of review in the second year took place in the beginning of each organ system block, which is somewhat expected. An important question to consider when looking at these redundancies is whether or not they are appropriate redundancies. Evaluators judged that most, if not all, of the redundancies between the first and second years were born out of necessity, given the gap in time between coverage of a topic in the first year (normal processes) and its corresponding material in the second year (abnormal processes).

An example includes the fact that second year students may reasonably need a review of normal anatomy and physiology that was taught in the first year before learning pathology taught in the second year. Therefore, in the context of a "first year normal processes, second year abnormal processes" curricular model these redundancies are appropriate. However, if the first two years were integrated to eliminate the time between the normal and abnormal processes for a given organ system, these redundancies would become unnecessary. If, in the latter context, these redundancies were eliminated (i.e., presumably the review lectures and small groups in the second year would no longer be taught), just under four

weeks (about 75.5 hours) of instructional time would be saved.

Redundancy between Courses in a Single Year. The findings in this category represent redundancies that occur within each year (horizontally redundant). In their evaluation of the curriculum, student evaluators found no significant redundancies within the first year curriculum. Only four redundancies were found within the second year curriculum. These included two redundant topics between different blocks, and two redundant topics within a particular course block. Unlike the investigation of redundancy across years where the necessity of the redundancy depends upon the structure of the preclinical curriculum, evaluators judged the redundancies in this category to be unnecessary. Additionally, discerning redundancy within the second year material was not as obvious as across year redundancy. Therefore, to estimate how much instruction time would be saved by eliminating these redundancies, we simply halved the total amount of time spent covering these topics, resulting in 11.5 hours, or about three days, of potential instructional time saved.

Hours Spent in Small Group on Material Introduced in Lecture. Before beginning the review of the preclinical curriculum, the evaluators anticipated there would be considerable overlap between the material taught in lecture and the material taught in small groups. Although this overlap is technically a "within-year redundancy," evaluators chose to investigate this redundancy separately for a couple of reasons. First, many small group sessions intentionally repeat material introduced in prior lectures for the purposes of reinforcement, utilization of different learning modalities, and application of the pathophysiology learned in lectures via clinical reasoning. Presently, the vast majority of small groups use a case-based format to review and expand upon a subset of the material that was introduced in the previous day's lectures, although there are a couple of notable exceptions in which new material is introduced in small groups. Second, the evaluators knew through their time spent interacting with faculty on curricular issues that medical education is likely heading toward more small group and team-based learning, with less time spent in traditional lecture. As a result, evaluators did not think it was appropriate simply to eliminate small groups just because they discuss much of the same material already covered in lecture. Nevertheless, students spend a total of 266 hours, or a little over 13 weeks, in small group. With exception to two courses that cover new material (about 19 hours), students spend the vast majority of small group time (247 hours) covering material that they have already seen before in lecture. This overlap represents a potential area to increase learning efficiency if the goal is to reduce time in the preclinical years.

Estimating Time Saved by Eliminating Redundancy in Small Groups. Unfortunately, it is difficult to find the right balance between new material taught in lecture and new material taught only in small group. Nonetheless, the evaluators presented the following model based on the fact that current medical students spend 247 hours of small group time covering material, which they have already been introduced. Evaluators made the assumption that, in general, small groups cover half as much material as lecture in about twice as much time, meaning that lectures are four times as efficient as small groups. If the curriculum were changed such that the material currently taught in small group were taught only in small group (instead of both lecture and small group), with no other changes, then approximately 62 hours, or three weeks, of instructional (lecture) time would be saved (247/4 = 61.75 hours). This model keeps the current amount of small group time the same, and all of the material not discussed in small group would continue to be covered in lecture. Although this is just an estimate, it underscores the fact that by reducing some of the overlap between lecture and small group, in this instance by teaching more material only in small group, the preclinical time can be shortened and the curriculum more streamlined.

Material that was Excessively Detailed. The findings in this category represent content the evaluators judged to be covered to a greater depth than was needed for both taking Step 1 and starting the third year of medical school. This material falls roughly into two categories: (1) fundamental basic science concepts in the first year and (2) overspecialized clinical content in the second year. With regard to fundamental basic science concepts covered in the first year, it is important for medical students to be exposed to these concepts. However, spending lots of instructional time giving numerous detailed examples to illustrate these concepts is met with diminishing returns with respect to its relevance to clinical application. With regard to overspecialized clinical content in the second year, some material was simply beyond the scope of providing students a general understanding of the concept. Student evaluators believed that such material would be

more appropriate for a third or fourth year medical student, or perhaps someone in post-graduate training. The evaluators noted that they believed as much as 25% of excessively detailed material (about 18.25%) could be eliminated, thus yielding nearly one week of time that could be spent more effectively.

Total Amount of Curricular Redundancy. Student evaluators discerned a good bit of redundancy in the medical school curriculum. Redundancy stemmed primarily from four distinct areas, but was most prevalent between the first and second year, and between lectures and small groups. Full results are presented in Table 1.

Table 1
Potential Area for Reduction and Potential Hours Saved

Potential Area for Reduction	Potential Hours Saved
Redundancy between first and second year	75.5
Redundancy between courses within a year	11.5
Redundancy between lecture and small group	61.75
Excessively detailed material	18.25
Total	167 hours (or 8.35 weeks)

Synthesis of Information and Faculty Judgments. At the conclusion of the study, the two student evaluators presented their evaluation before the School of Medicine's Curriculum Committee which consists of a wide array of teaching faculty and representatives from various medical specialties. The student evaluators presented their goals, methodology, findings, and limitations of the work. Faculty asked questions regarding additional points of clarification and engaged in a lengthy discussion regarding which types of redundancies were most detrimental to the medical school's educational product and where unwanted redundancies might be removed. The collective faculty judged the evaluation to possess a great deal of merit, and in the months following the evaluation have continually used the findings as a helpful tool for identifying possible places where some cuts can be made in the curriculum. That said, simply identifying places for potential cuts does not ensure eventual cuts will be made. Ongoing debate and dialogue regarding the curriculum are necessary to appreciate the full experience of a curriculum redesign.

Discussion

Redundancy in an educational curriculum can have a number of positive and negative effects. While some redundancy is useful, other forms of redundancy are not. The evaluation described in this article attempted to use advanced medical students that had recently completed the vast majority of medical school to identify undesirable redundancies within a highly-integrated medical school curriculum. Critical attention was paid to redundancies that might result in an inefficient use of time so as to identify opportunities where the curriculum might be streamlined and improved.

The context presented in this article of a highly-integrated medical school in which hundreds of faculty are involved in instruction can make an evaluation of this kind incredibly laborious for the evaluators. Fortunately, most educational departments, schools, and colleges are not nearly as integrated, thus making projects of this kind far more feasible. A simple example might include a doctoral program in a College of Education. A small team students who have completed all the formal coursework might review all the courses, their content topics, readings, etc. and discern both the quality and quantity of redundancies as outlined above across the department, program, etc. Such a task could be completed rather quickly, and because of this benefit, may increase the likelihood of finding multiple student evaluators to assist with the evaluation.

As mentioned previously, the typical method for evaluating curricular redundancy involves the opinions and judgments of faculty. Unfortunately, the view from the faculty perspective is somewhat fragmented and leaves a great deal of important information unattainable. Having the consumers of the curriculum, particularly those who just completed it, provide insights about redundancy are likely to yield far more valid information than the traditional approach.

Implications

We believe this work will benefit other individuals charged with curricular responsibilities in three key ways. First, we demonstrate a useful methodology that solicits invaluable feedback from

students. This is critical as students are both the primary consumers of the curriculum and the persons who have the greatest insights about curricular redundancy. We strongly recommend others incorporate advanced students in their curriculum redundancy investigation processes.

Second, student feedback identifies substantive pieces of the curriculum that are redundant. This is important because instructors are not always aware of what one another are doing and how they are doing it. Student feedback can fill this critical gap in communication and potentially result in fruitful discussions that may lead to effective pedagogical changes. Third, student evaluators were able to quantify the amount of redundancy in the present curriculum. This is critical, as it identifies the extent to which undesirable redundancy is a problem and provides curriculum developers with an empirical estimate of time and space for prospective revision and improvement, as well as provide them with a key opportunity to respond with changes that will maximize learning opportunities.

Considerations for Curriculum Committees

Consumers of an evaluation report will also need to be guided towards particularly helpful things to consider. Considerations that would require critical reflection as to why certain things are done and which pieces are absolutely essential should be explicitly discussed. In the context of medical education, the evaluators posed the following questions for curricular decision-makers: What are students gaining from this experience? Do all physicians in today's era of health care need to have these experiences in their training, and are they likely to use the resulting skills or knowledge directly in their future practice? Do we continue to include these educational experiences simply because we have always done so? Finally, if these experiences are indeed necessary, is there a more efficient way for students to learn from them? These types of questions are likely to generate some useful starting points for discussion, and hopefully, lead to some favorable outcomes.

Limitations and Considerations for the Future

It is important to note several limitations of this evaluation strategy. First, subjectivity is somewhat inescapably linked to evaluations in which human evaluators provide judgments. This evaluation was no different, as student evaluators had to make decisions about whether material was redundant, if the redundancy was appropriate, and/or if lectures were excessively detailed. Further, anytime something is removed from a curriculum there is a risk that educational outcomes may be impacted. Important questions such as "What do we stand to lose by eliminating redundancies?" should also be considered.

Second, having only two student evaluators posed concerns about both the accuracy and reproducibility of the findings. As noted previously, having individuals closest to the curriculum, namely advanced students, conduct the evaluation lends content expertise to the process. However, content expertise does not necessarily equate to accurate judgments or judgments that would be representative of other advanced students in the program. In some ways the inherent limitations of qualitative inquiry are inescapable without a significantly larger panel of student evaluators. A stronger evaluation design might mimic that of a performance assessment panel in which multiple evaluators make judgments about the exact same information. This process would allow the judgments to undergo evaluation for inter-rater reliability and agreement and could lend additional evidence to support various aspects of validity.

Third, student evaluators did not take into account small redundancies that generally take up minimal amounts of instructional time (less than 30 minutes). While it is true that small redundancies can and do add up, this level of specificity was intentionally avoided because the evaluators were serving as the research instrument and did not want to introduce unwanted noise into the measurement system. The evaluators believed a truly comprehensive report of redundancies would likely have resulted in overwhelming detail that might have otherwise obstructed their vision with regard to identifying major curricular trends. Having to switch one's cognitive processes repeatedly over the course of a very tedious task is almost certain to become problematic eventually. We insist that evaluators considering adopting the strategy presented in this report carefully weigh matters of substance and specificity. An imbalance of either factor could potentially result in a threat to validity.

Fourth, it may be helpful to have an instrument that can be used to help students more objectively construct standards and make measurements. Although the two student evaluators did their best to construct clear criteria and measure it in a reproducible way, their specific attempt is not only limited by a small sample of evaluators but their lens for making judgments are

unlikely to be replicated exactly by future student evaluators. Thus, a formal instrument would provide a more structured and more longitudinally-friendly tool for student evaluators.

Finally, persons interested in conducting similar evaluations in different contexts may find the process to be quite different than that presented in this article. Medical school curricula are very highly structured with most faculty relying on traditional lecture methods to convey instruction. Although recent trends for "flipped classrooms," more peer-to-peer learning activities, etc. are becoming increasingly popular in medical education, most medical school curricula are quite different from other academic disciplines. For example, most graduate programs in the social sciences rely less on lecture and more on required readings and thoughtful discussions. Evaluating curricular redundancy in this content may be far less cumbersome in terms of time commitment, but may present some additional and unique challenges.

Conclusions

This paper described a student-led strategy for evaluating redundancy in a medical school curriculum. While some of the context-specific findings of the report will be of more or less relevance to others, we believe the evaluation strategy and approach is particularly unique and noteworthy, especially for individuals considering a similar evaluation of their educational curriculum. With any evaluation, accurate and reproducible findings are paramount. It is our hope that others will benefit from this work and be able to build on this evaluation strategy to make it more robust.

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