New Approach to Teaching Basic Science Courses: Biochemistry and Molecular Biology in the Block System of Curricular Design[1]

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The overarching goal for curricular content in Biochemistry and Molecular Biology was to enable students apply basic science material to the clinical setting. The traditional curricular delivery system was modified to allow students to immerse themselves in one topic, to enable students to achieve a 90 percent competency level, to encourage peer teaching, and to enhance communication skills. Students received 216 contact hours in two blocks. Educational activities included lecture, case-based learning, presentations, and role-playing. All activities sought to apply basic scientific principles to clinically relevant situations. Novel methods of curricular delivery were designed to enhance student achievement. Student evaluations revealed the ability to apply basic science principles to clinical situations. They demonstrated a deeper understanding of the subject matter as evidenced by the achievement of 90 percent competency. Additionally, they showed improvement in social and academic skills. Curricular redesign can contribute to achieving desired educational outcomes. Nontraditional teaching methods can foster greater depth of knowledge and enhance the integration of basic and clinical sciences.

INTRODUCTION

As a new school of pharmacy, the Western University College of Pharmacy is exploring many innovative teaching methods, some of which are presented in this report. The teaching innovations described here include various classroom methods that are supported by college-wide innovations in curricular design and delivery. It is this novel approach to the curriculum that makes the classroom teaching methods possible; therefore, an orientation to the Western University system is addressed first.

CURRICULUM DESIGN

The curriculum is organized into the following broad-based components: (*i*) Core Academic Program; (*ii*) Pharmacist Development Program; (*iii*) Elective Program; and (*iv*) Patient-Based Program

Core Academic Program

This is the central educational component of the first three years of the PharmD curriculum. It represents an integrated approach to pharmaceutical education taught by teams of clinical and basic science faculty, and emphasizes fundamental biomedical and pharmaceutical concepts as well as principles of pathophysiology and pharmacotherapy.

The Core Academic Program consists of five sections representing the following major content areas: (*i*) fundamentals of therapeutic agents; (*ii*) biochemistry and molecular biology; (*iii*) metabolism and nutrition; (*iv*) biological basis of disease; (v) management of homeostasis.

Based on the organ system approach, each Management of Homeostasis block seeks to amalgamate the following ten concepts:

1. History: Historical significance and perspectives, classic articles, studies, etc.;
2. Biomedical science: Review of basic and pharmaceutical science concepts relevant to the organ system;
3. Physical Assessment: Review of key aspects of assessment parameters; Clinical laboratory and diagnostic tests and procedures;
4. Pharmacology;
5. Pathophysiology;
6. Therapeutics: Prescription and nonprescription drugs, review of pharmaceutics and pharmacokinetics;
7. Clinical Services Management: Outcome, drug use evaluations (DUE), disease management, protocols, pharmacoeconomics;
8. The Competent Practitioner: Service, education, and research come together to explain how future graduates may become competent in a specialty area in this organ system. Practitioners from various specialty areas are invited to give an overview of contemporary practice and discuss how to work with the health care team.
9. Patient Care Parameters: Education, compliance, wellness, public health, quality of life issues, communications.
10. The Future: New research, drug protocols are presented and discussed. Students learn to understand how the management of this organ system is changing, and how they can track and respond to changes occurring in the environment.

Pharmacist Development Program

This is a longitudinal, problem-based learning component of the PharmD curriculum that is designed to introduce students to the complex nature of the emerging health care system. This component is intended to assist students in development abilities that will be critical in enabling the

[1]Manuscript based on portfolio submitted to 1997 Council of Faculties Innovation in Teaching competition.

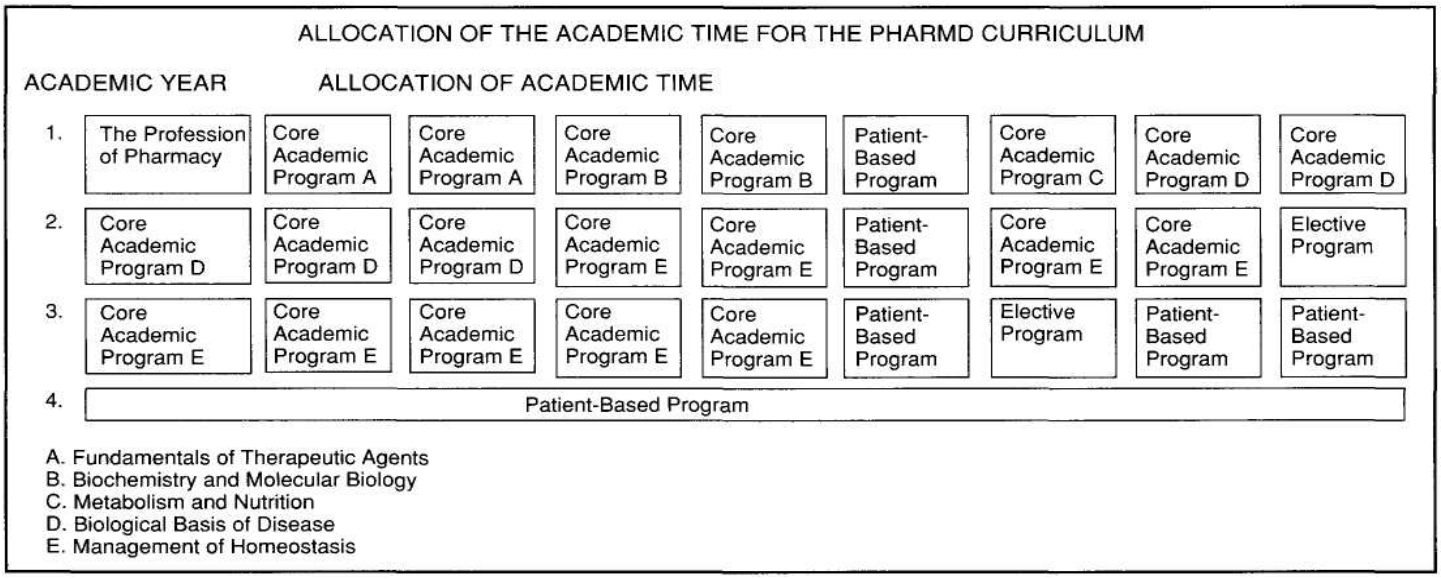

Fig. 1. The PharmD curriculum

health care practitioners to respond both to patients and their environments in the future. Students focus on the following subject areas:

- Health Care Economics and Finance
- Health Care Systems/Managed Care
- Total Quality Management
- Outcomes Measurement
- Biostatistics
- Epidemiology and Population Health
- Ethics and Jurisprudence
- Clinical Policy Analysis
- Wellness, Health Promotion, and Disease Prevention
- Medical and Drug Literature Evaluation/Informatics
- Interpersonal Skills and Concepts of Human Behavior

Elective Program (Area of Concentration)

This component allows students the opportunity to pursue in-depth areas of concentrated study.

Patient-Based Program

This component begins with early student involvement with patients, and builds toward intensive clinical practice experiences in the clerkships of the final year. The emphasis in the Patient-Based Program is the development of the clinical skills necessary for the provision of pharmaceutical care. The following subject areas are included:

- Interviewing and Counseling Skills
- Physical Assessment
- Problem Solving and Decision Making
- Computer Use in Clinical Practice
- Continuity of Care
- Advisor/Advocate Program
- Pharmacy Practice Experiences

Allocation of Academic Time

The PharmD curriculum is delivered in block form (see Figure 1). The academic year is divided into nine blocks. Each block is 18 days in duration with a four- to five-day break scheduled between blocks. Students are engaged in active learning formats with faculty and peers for six hours daily. The blocks allocated to the five major areas of the Core Academic Program are identified by their corresponding letters[2].

The block system offers several advantages: (*i*) It provides students the opportunity to read, listen, discuss, reflect upon, and study a subject area intensely without distraction from other subjects, (*ii*) The amount of class time each day (6 hours) offers opportunity for, and demands varied class activities, especially active modes of learning. There is time for discussions, case presentations, simulations, role playing, debates, group projects, and other activities encouraging active participation. Such activities foster student interest and motivation. (*iii*) It is conducive to the development of interpersonal skills because students are encouraged to work together several hours a day.

Evaluation and Assessment

Assessment is multifaceted, including both traditional and nontraditional methods to monitor effectiveness in achieving the curricular outcomes established for the PharmD program. Assessment is centered on students achieving higher levels of competency than are required in most pharmacy programs.

Traditional quizzes and examinations used are generally in essay format. Additionally, students are evaluated on written reports, poster presentations, and oral presentations. Students maintain a personal portfolio with examples of their best work. The student's faculty reviews the portfolio with the student on a quarterly basis.

Nontraditional methods include evaluation, remediation, and collaborative activities. Student evaluations are completed on a quarterly basis with data describing progress obtained from peer (team) evaluations, self-evaluations, and review of grades. The faculty mentor assigned to each student meets and discusses progress made, and develops a performance plan for the student's continued progress. Portfolios are also reviewed at this time.

[2]Please note that the curricular plan shown in Figure 1 and described in the text represents the plan as conceived and implemented for the Class of 2000. Modifications to the plan have been made subsequent to the submission of this work.

The College of Pharmacy has established very high expectations for its students. Each student must achieve a minimum of 90 percent on all exams, quizzes, papers, and as a final block grade. If a student does not initially meet this standard, he or she begins a process of remediation. The purpose of remediation is to identify weaknesses and to design learning activities to bring the student up to the desired competency level. The remediation process entails the student meeting with the faculty member(s) responsible for the material and/or with his or her team to give extra assistance in learning what was missed. Once this is accomplished, the student is required to demonstrate achievement of the 90 percent standard. This immediate intervention ensures that students keep pace with their classmates and do not fall behind in their studies.

The curriculum is student-centered and each student is assigned a team. Teams of six to seven students collaborate to complete assignments such as case projects, posters, and presentations. Students are responsible for teaching themselves and each other. To encourage collaboration, there are several block assignments, both social and academic, that require teams to work together.

LEARNING OBJECTIVES FOR THE BIOCHEMISTRY AND MOLECULAR BIOLOGY BLOCKS

Biochemistry and Molecular Biology are two fundamental basic science subjects in most pharmacy school curricula. A deep and thorough knowledge of these subjects sets the foundation for a better understanding of various disease states and their management. Five major learning objectives and desired outcomes were identified and addressed during the Biochemistry and Molecular Biology Blocks. These objectives guided the block faculty in the design of all the teaching innovations implemented within the blocks and were as follows:

Objective #1: To correlate the basic science of Biochemistry to its clinical and practical applications.

Although Biochemistry is closely linked to clinical sciences, the traditional method of presenting this subject rarely correlates the basic science to its clinical and practical applications. As college of pharmacy faculty, we felt that we needed to teach our students not only the basic elements of Biochemistry (*e.g.*, pathways, enzymes, and Molecular Biology) but also the clinical aspects of this science. Although each individual lecture had several learning objectives, the major overall learning objective of the Biochemistry blocks was to ensure that our students develop the skills to apply Biochemistry in the clinical sciences (*e.g.,* management of homeostasis). The goal was to assure that our students will be able to use their knowledge of Biochemistry in providing quality pharmaceutical care to their patients.

Objective #2: To foster peer teaching and team work.

Peer teaching is one of the principal educational methods used in our program. Activities are designed to encourage students to learn from and teach each other, and to foster cooperation both within their teams and between other teams. At the start of the year, students were randomly assigned to teams composed of six or seven students. Membership in a particular team was maintained for the entire year. During Biochemistry blocks, teams were challenged daily with cases and problems which required them to apply theoretical principles of Biochemistry and Molecular Biology. For each case or problem, they had to develop alternative solutions and learn to rationally defend the solutions they felt were best. This interactive format developed a deeper level of understanding, built trust between team members, required students to communicate effectively, fostered acceptance of responsibility, and taught students how to build consensus. Students were also encouraged to be involved in peer learning between their team and other teams. A team collaboration award was given at the end of each block to recognize the team that contributed the most to effective instruction of the whole class. Today's pharmacist functions less autonomously than in the past, and certainly, the pharmacist's role as an integral member of the health care team will become increasingly important. We as a faculty believe that exposing our students to peer learning and teaching as well as giving them opportunities to practice teamwork, is essential to their future success as pharmacists.

Objective #3: To develop effective oral and written communication skills.

One of our curriculum is to ensure that our graduates will be able to communicate effectively. Our students had numerous opportunities to exercise their communication skills. Through peer teaching, class presentations, and team collaboration, our students became more adept at being empathetic and perceptive listeners. They were better able to identify and understand personal values, strengths, weaknesses, and biases that influence interpersonal skills. The teaching strategies employed also encouraged students to use appropriate communication strategies to convey his/her thoughts and ideas and to elicit feedback to verify understanding. Pharmacists today serve as society's source of information regarding pharmacotherapy, treatment modalities, and pharmaceutical care; therefore, a pharmacist's ability to communicate oral and written information effectively to the lay public as well as other health care professionals is a crucial element of the profession.

Objective #4: To achieve excellence by requiring a competency level of 90 percent.

Our faculty is committed to helping students achieve excellence, with the belief that excellent performance lies within the grasp of all our students. We believe that the objective of educators and students should not be the achievement of a certain score, but rather the attainment of a certain level of competence. In fact, it is our opinion that demonstration of knowledge of 60-70 percent of course material is not adequate for students preparing to be pharmacists. Accuracy in all aspects of the practice of pharmacy is crucial because a patient's welfare as well as the integrity of the profession is at stake. Therefore, the faculty has set achievement of a competency level of 90 percent as our standard. During Biochemistry and Molecular Biology blocks, a competency level of 90 percent was assured using individual and group examinations, quizzes, and presentations (see evaluation data).

Objective #5: To integrate new computer technologies fully into the student learning process.

Computers and computer technology are the major driving force behind today's information age. Computers permeate almost every aspect of our lives and certainly are ubiquitous in all pharmacy practice settings. Thus, it is imperative that pharmacists have more than a working

knowledge of computer technology. In order to be competent practitioners, pharmacists must be aware of, and adept at using computers as a tool to provide quality pharmaceutical care. With this in mind, we require that all students own laptop computers and use them extensively throughout their tenure at Western University. In the Biochemistry and Molecular Biology blocks, instructional activities and assignments were designed to promote computer and computer technology use throughout the blocks.

DESCRIPTION OF TEACHING INNOVATIONS

Content

In a broad sense, the content of the instructional units considered here includes Biochemistry and Molecular Biology. This material was presented to students in two blocks (Blocks 4 and 6) totaling 216 contact hours of instruction. While the essential content of the Biochemistry and Molecular Biology blocks is not new, methods of delivering that content (discussed in the process section below), as well as correlating the basic science to its clinical application to the extent done in this block was most definitely innovative. Clinical case studies illustrating each biochemical pathway, Molecular Biology concept, or hormonal action was an integral part of each subunit within the block. In fact, students generally were given at least two clinical case studies for each pathway or hormone. Hence, the practical application of Biochemistry and Molecular Biology concepts to disease states and pharmacotherapy was reinforced on a daily basis.

Student Audience/Level of Student

These blocks were presented to first-year PharmD students approximately midway through the first-year curriculum. This first-year class was composed of 66 students, 60 percent of which have a Bachelor's or other advanced degree. Relevant pre-pharmacy prerequisite courses include general and organic chemistry, human anatomy (all with labs). The class had a wide array of exposure to Biochemistry. Roughly one-third of the class had at least one previous Biochemistry class, while a few students had a Bachelor's degree in Biochemistry. None, however, had taken a Biochemistry or Molecular Biology course that emphasized clinical applications of the basic science.

PROCESS

Instructional Materials

All lecture materials were provided for students in the form of handouts created by individual instructors. Microsoft Word files containing the handouts were loaded onto the University file server at least two days prior to the lecture, which allowed students to download lecture materials directly onto a disk or his/her laptop. This was an example of a strategy employed to familiarize the students with computers and computer technology in a very practical way. There were no required textbooks for the Biochemistry/Molecular Biology blocks. The handouts contained very detailed information regarding pathways, concepts, etc. as well as the case studies. In some cases, supplemental readings were listed on the handouts to assist students who desired additional in-depth self-study. However, the handouts contained all information pertinent to examinations as well as the case studies.

A Typical Day

A variety of instructional methods are employed during each six-hour day; however, typically, the instructor begins with the presentation of a case study related to the biochemical pathway or general concept to be covered. The instructor makes observations regarding the clinical signs and symptoms related to the case as an entree to discussion. Following the discussion, the relevant biochemical pathway or concept is discussed in a more traditional lecture format. Once the pathway or concept has been presented in detail, another case is presented with a series of questions. The students then break into teams to discuss both cases and the questions. During the team activities, the instructor serves to guide and facilitate interaction within each team. When the team has discussed the case thoroughly and solved the problems posed to them, the class reconvenes as a whole. Teams then take turns presenting their answers to the questions allowing for more discussion and interaction between teams. Oftentimes teams have differing opinions regarding answers and are given the opportunity to defend alternative positions, which contribute to the overall learning experience. Throughout these activities the instructor functions more as a facilitator to guide students in the learning process than as a pedagogical director.

Other Learning Activities

In addition to the case-based lecture format described above, one to two days were set aside in each block for team presentations. In the Biochemistry block (Block 4), each team was responsible for presenting a specific biochemical pathway and clinical disease state reflecting errors in metabolism. Most teams chose to use computer programs (*e.g.,* Microsoft Word and PowerPoint) to aid in the design of their presentations. These presentations gave the students the opportunity to both teach and learn from their peers. Additionally, these activities gave students exposure to commonly used word processing and graphics software.

The majority of the Molecular Biology block dealt with hormones and their mechanisms of action on a molecular level. For the presentations in this block, each team was responsible for knowing the etiology, signs and symptoms, and simple treatment modalities for 12 endocrine diseases. Students demonstrated their knowledge in a role-playing exercise. A faculty member played the role of a patient with one of the disease states, and team members acted as a collaborative health care team responsible for determining which disease state the patient had, explaining the physiological basis for the signs and symptoms manifested, and suggesting a simple treatment modality. The disease state each team received on presentation day was entirely random, so the teams did not know prior to the class which disease state they would be presenting. This format was chosen, in part, because the students had just completed the patient-based block (Block 5), in which they had learned patient history-taking, physical assessment and design of pharmaceutical care plans. This role-playing exercise allowed the students not only to learn about the various disease states, but also gave the students the opportunity to practice their patient-care skills. Additionally, this was the student's first exposure to extemporaneous presentation. Because the disease state each team presented was unknown to them until the time of presentation, students were required to think on their feet, prioritize questions, and eliminate possibilities in order to arrive at the correct diag

nosis. The presentations were videotaped to enable students to critique their own work. The specifics regarding this exercise, disease states, and evaluation criteria were given to the students in a handout on the first day of the block.

Examination and Evaluation

The examinations, evaluations, and remediation were important process components of the teaching methods employed in the Biochemistry and Molecular Biology blocks. The examinations were designed to be reflective of the case-based approach to instruction and hence, contain cases, propose hypothetical disease states or treatment modalities, and emphasize problem-solving ability rather than rote memorization of pathways.

Examination Process

Perhaps one of the most important innovations piloted in the Biochemistry block and continued in the Molecular Biology block was the practice of taking each examination as a team. On examination day, all students first took the exam individually and then took the exam again as a team without consulting notes, books, or the instructor. Taking the exam as a team produced many desirable outcomes. Students had immediate feedback on how they did on the exam and discussion and interaction were fostered within the team. Learning of the material was also enhanced as team members debated amongst themselves regarding the exam answers. Students received 10 percent of the points scored on the team exam as a bonus to add to the score of the individual exam.

Remediation

The overarching goal for students is achievement of a competency level of 90 percent for the entire curricular content. Although this standard is high, students are given ample opportunity to achieve this level. For students who did not demonstrate this competency, intervention was immediate. Following each quiz or exam, students who did not earn a grade of 90 percent entered the remediation process and at some point, assured the instructor(s) that the remediation process has been successful in bringing their competency level up to the standard. The methods employed to insure that remediation had worked differed in Block 4 and Block 6. In Block 4, students verbally demonstrated competency to the instructor only on materials they had difficulty with on the initial exam. For example, if a student did not achieve 90 percent on one instructor's portion of the exam, the student made an appointment with that instructor to verbally remediate that portion of the exam only. In Block 6, however, regardless of the portion of the exam completed successfully, if a student received less than 90 percent overall, he/she was re-tested over the entire exam material again. Although the remediation exam covered the same material, the actual exam questions and cases were different. In either block, regardless of the score on the second exam, the highest attainable score following remediation was 90 percent. If the remediation exam score was lower than the first, the score achieved on the first exam was used as the final score for that exam.

Contribution of the Curricular Design to Process

The block system offers many advantages to this instructional format. Because the day is not broken up into arbitrary 50-minute intervals as with traditional class periods, breaks were taken as they occur naturally in the flow of instruction. Additionally, because students did not have to rush off to another class, there was ample time to spend reviewing and explaining more difficult topics in great detail. Moreover, student interaction and involvement was less hindered since time constraints were minimized. In fact, contact hours provided by the block system (216 for the two blocks in this submission) more than double the contact hours for Biochemistry and Molecular Biology in traditional instructional systems. This and other innovative delivery methods facilitated a deeper understanding of the material, aided in exploring the clinical applications of Biochemistry in greater detail, and helped make the attainment of a 90 percent competency level a reality.

Evidence of Student Learning

The various teaching methods and innovations described in the preceding pages were extremely effective in achieving our desired goal of a 90 percent competency level for students in Biochemistry and Molecular Biology. Overall, approximately three-fourths of the class achieved 90 percent following the first examination (70.5 percent in Block 4 and 72.8 percent in Block 6). Furthermore, following the remediation process, exam scores improved over the first exam in 98.6 percent of the cases (204 out of 207 remediation attempts). This improvement may be attributed at least in part, to the team examination innovation as well as the remediation process. Results of team exams revealed an overall team exam average of 94 percent. Additionally, the class average final block score for Block 4 was 93.4 percent and 94.4 percent for Block 6. Only one student did not demonstrate 90 percent competency in one of the blocks. That student was given the opportunity to remediate the entire block during the summer.

Subjectively, students became more adept at problem-solving as evidenced by improved performance on exams. Additionally, presentation and communication skills improved from Block 4 to Block 6. More team members became actively involved in making presentations to the entire class. Even shy students took a greater role in oral communication both within their own teams as well as to other teams. Additionally, as students became more proficient with their computers, the quality and sophistication of computer-generated presentations improved dramatically over the course of these blocks.

EVALUATION

Evaluations of the Biochemistry and Molecular Biology blocks were very positive. Although individual instructors did not evaluate each other, quality control was performed on the handouts submitted mostly with regard to content. Students, on the other hand, had several opportunities and methods by which to evaluate the blocks both in terms of individual instructors, content, and policies. Every student completed post-block evaluation questionnaires and the data was summarized and distributed to faculty members involved in teaching the blocks. These questionnaires revealed that students felt that instructors were very successful in achieving the block goals and objectives. Furthermore, students felt that the material presented was very stimulating, challenging and relevant.

In addition to the anonymous written questionnaire, ten students were chosen by their classmates to participate

in a focus group discussion regarding the Biochemistry and Molecular Biology blocks. From the block questionnaires, questions were developed that were designed to elicit more detailed verbal responses from students in the focus group. The resultant data was very rich and will be extremely useful to faculty for improving the blocks for next year. For example, the focus group students indicated that although the presentations in both blocks helped in their overall understanding of the material, the role-playing exercise utilized in Block 6 was felt to be much more effective. The students felt that injecting the element of surprise by randomly selecting the disease state to be presented added interest and made the presentations much more stimulating to the class as a whole. One student commented that even as an audience member, she was more actively involved in trying to figure out the disease state the "patient" had and consequently, the entire experience was more enjoyable.

Regarding taking the exams a second time as a team, focus group participants' overall impression was very positive. The students expressed that this method really helped them understand the material better and helped them learn to communicate and debate points effectively. The team exam also fostered teamwork(as one focus group student observed, "This is where we actually started functioning as a team."

The focus group discussed at length the class' varied Biochemistry background and how that affected learning the material in the block. For students who hadn't had Biochemistry before, the material was very challenging, but very interesting, especially since the basic science was applied to clinical practice. For the students that had already had Biochemistry at other institutions, the format of presenting not only the biochemical pathways, but also case studies, disease states, and applications made Biochemistry new, interesting, and different. Moreover, as one student who had Biochemistry before remarked, "Before, I had a set way of studying Biochem, memorize. With this format, I have to not only memorize (the pathways), but relate and apply them." Overall, students felt that the presentation of case studies helped them understand the material better.

Students who participated in the focus groups were also very enthusiastic about the block system and (perhaps surprisingly) the requirement of a 90 percent competency level. Students enjoyed being able to concentrate on one subject at a time and believed that it enhanced the learning process in general. They remarked that in traditional systems, one course may be sacrificed for the sake of trying to pass another course and the result is not being able to do justice to either. Regarding the 90 percent competency, perhaps one student put it best when he said, "The difference is studying to pass the exam and studying to understand the material. In traditional systems, students oftentimes study just enough to achieve a 60 or 70 percent passing score. That is not possible in this system. In order to get the 90 percent you have to be able to actually understand the material in detail and be able to apply it." Additionally, because the students are all required to achieve the same high standard, they did not feel the competition to get grades. This in turn, fostered teamwork and made students more willing to help one another.

PERSONAL REFLECTIONS

Why Were the Innovations Implemented?

These innovations were implemented to meet our goals that were set prior to the start of the Biochemistry and Molecular Biology blocks. Specifically, the teaching and assessment methods employed during the Biochemistry blocks helped the students to analyze and synthesize data effectively, integrate the basic and clinical aspects of Biochemistry and develop peer teaching and communication skills through team work. In addition, group assignments, case studies and class presentations enhanced the ability of the students communicate effectively with their peers and teachers, provide constructive criticism of their peers, improve confidence levels, teaching, learning, and computer skills.

What Was Successful?

Emphasizing the Clinical Applications of Biochemistry Through Presentations of Case Studies. In general, students became adept in establishing correlations between basic science aspects of Biochemistry and application in the clinical setting. This is a significant achievement, since traditional teaching practices in Biochemistry and Molecular Biology have tended to focus on memorization of pathways and have generally failed to provide substantive and relevant connections between basic and clinical sciences. Additionally, the teaching methods employed proved to be quite effective in promoting critical thinking and problem-solving skills in our students. Moreover, students have indicated that learning the clinical applications along with the basic science component has made the subject matter more interesting and relevant.

Team Examinations. The innovation of taking exams as teams was extremely successful in helping us to attain several of our objectives for this block. First of all, the team examination turned out to be a significant contributor to improving teamwork and individuals in teams united in the common goal of successfully completing the exam. Secondly, the block instructors and students both felt that the team exam helped students achieve a deeper understanding of the material. Also, the team exam was an important exercise in consensus-building within the team. Finally, the team examination helped students practice oral communication skills, critical thinking skills, deductive reasoning skills, and helped students develop the confidence to express and defend their views and opinions.

Team Presentations. Team presentations during the blocks were also extremely successful in helping attain our stated objectives for these blocks. The presentations helped students understand the material better, and because the presentations focused on disease states, assisted students in learning to apply the basic science of Biochemistry to clinical manifestations biochemical or metabolic errors. Additionally, presentations gave students opportunities to use their laptops extensively and to familiarize themselves with commonly used computer software programs.

Ninety Percent Competency Level Requirement. The goal of reaching a 90 percent standard of competency in all course work demanded a lot from our students. However, as we have demonstrated, the attainment of this goal is possible through the innovative teaching and assessment methods being employed in our curriculum. Overall, the success rate among students to achieve this level of competency was very high. Students no longer study "just to pass", but study

to understand and retain the material. In addition, this high standard significantly reduced competition between students. Instead of competing with others for grades, which is commonplace in more traditional systems, this standard motivates the student to compete only with himself/herself. Moreover, there was no "coasting." Because of the stringent standard, even the best students study more diligently and for more detail than in traditional systems.

Overall Curricular Design (The Block System). As a system in which students totally immerse themselves in one subject for an intense 18-day period, the block system was instrumental in ensuring the student successes in learning that we observed. The extended contact hours devoted to one subject, played a major role in helping our students to achieve the 90 percent standard mentioned above. Additionally, evidence from examinations and self-assessment by students indicated that a deeper and more meaningful understanding of the material was directly attributable to the block format. The block format also fostered student participation in class, giving them time to think about the material as it was presented and to ask intelligent, often insightful questions during class.

What Was Unsuccessful?

Overall, the block system along with all innovative methods of teaching and assessment provided positive results in our curriculum design. However, sometimes modifications are warranted to adjust to an unforeseen problem area. One such occurrence is mentioned here.

Modifications were made in our remediation policy. The earlier practice of verbal remediation was discontinued. In addition, the practice of remediating only those portions of the test where the student did not achieve the required competency level was also discontinued. Instead, modifications were made wherein students below a 90 percent competency level were required to take a new, written remediation quiz or examination in its entirety. The results of the remediated exam were compared with the scores in the original exam and the better of the two scores was chosen as the grade for that examination. However, the original policy wherein students could only remediate up to a 90 percent level was not changed. It was also decided that students who did not successfully demonstrate a competency level of 90 percent at the end of the block would be allowed to remediate that particular block during the summer. These modifications were approved by Pharmacy faculty and adopted as a change in policy.

Overall, the changes implemented in the remediation policy have been well received by students and faculty. Students were more aware and conscientious about completing assignments, working in teams and study groups and helping each other to do well in the examinations. This change in remediation policy also allowed us to identify students who are consistently performing under the required competency level.

SUMMARY

As evidenced by student evaluations, student achievement statistics, and faculty reflections, the innovations described in this report have been successful at helping us achieve our stated objectives. Additionally, we believe that we have demonstrable proof that these innovations are an integral component to our students' success in learning the course material. However, it must be pointed out that the classroom innovations were combined with radical redesign of the curriculum and the curricular delivery system. Without this supporting infrastructure, successfully implementing the classroom innovations might have been very difficult, if not impossible.

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