Curricular Mapping for Program Improvement

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Objective: To illustrate a curricular mapping method and discuss its benefits for evaluation, assessment, and faculty education.

Methods: This was the first of a three-year project to examine the newly-revised School of Pharmacy curriculum. Tools were developed to capture data and automate analyses. Subcommittees consisting of two Academic Affairs Committee members, two faculty, and two student volunteers were formed to evaluate clusters of P1 courses. The instructor of record also evaluated his/her course. Evaluations will be compared, discussed, synthesized, and analyzed.

Results: The subcommittee mapping meetings and course-level mapping tool have uncovered duplicate lectures, small gaps in coverage, and objectives that need refinement. When all courses are complete, the program-level mapping tool will provide a comprehensive look at foundational science elements included in the first year of the curriculum.

Conclusion: Students have provided invaluable feedback throughout the process. The tools developed to capture and analyze data give a visual depiction of the course content and program status. Though a complete picture of program status will not be available until after the third year, steps can be taken to incorporate any noted content gaps in the preceding curricula. Faculty have been enlightened by the formal mapping process and now recognize its value for assessment and accreditation.

INTRODUCTION

Curricular mapping is a process used by instructional designers, curriculum developers, assessment and accreditation specialists, and other education professionals to examine the connection between course or program objectives (or outcomes) and curricular content and delivery[1-5]. The primary purpose of curricular mapping is to ensure that objectives are fully covered in a course/program. Lack of coverage, overlapping coverage, and various disconnects between objectives and content can be revealed by the mapping process. Varying levels (course, program, institution) and types of data can be examined in this way. Example types of data include objectives; outcomes; standards; coverage methods, hours, and levels; intended, actual, and learned coverage, etc.[1-5]

Ideally, the mapping process will take place as a program or course is being designed. However, faculty and administrators of many non-education degree programs are not fully aware of instructional design and do not understand its benefits. For curricula that have already been developed, mapping not only will provide valuable information to make improvements, it also will highlight the importance of traditional instructional design.

Once a mapping schema has been developed, the next consideration is developing or choosing the mechanism for data capture[8-10]. Creating and/or choosing the right tool will save time in collecting, compiling, and analyzing the data. Paper-based tools allow more portability, while electronic mapping tools provide the ability to

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Course Descriptors

Course #	PHAR		
Course title			Completion Date of Latest Data Entry/Revisions
Year (4 digits)			
Semester	☐ Fall	☐ Spring	
Credit Hours			
Coordinator(s)	#1:	#2:	#3:

Misc Course Information

Required or Elective?	☐ Required	☐ Elective	
Direct prereq for other courses?	☐ Yes	☐ No	
If so, enter course number(s)	#1:	#2:	#3:
Required readings?	☐ Yes	☐ No	
Textbook?	☐ Required	☐ Optional	☐ None

Course Objectives — **Revised Bloom's Taxonomy Levels (low-high)**

Type the course objectives & associate (with an 'x') each objective with the highest of the revised Bloom's Taxonomy levels. Examples of the taxonomy levels are located in a separate worksheet (tab). Finally, list the element #s (2nd tier - pastel rows on mapping worksheet) covered by the objective.

#	Objective	1 Remembering	2 Understanding	3 Applying	4 Analyzing	5 Evaluating	6 Creating	Appendix B Elements
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Comments								

Quizzes and Exams — **Course Objectives**

#	*Name or briefly describe the quizzes/exams & associate (with an 'x') each with 1 or more course objectives. Also indicate the (highest) level of the revised Bloom's taxonomy that is being tested.*	highest level	1	2	3	4	5	6	7	8	9	10
1												
2												
3												
4												
5												
6												
Comments												

Other Assignments/Assessments — **Course Objectives**

#	*Name or briefly describe the assignments & associate (with an 'x') each with 1 or more course objectives. Also indicate (with a 'Y' or 'N') if the assignment develops writing skills.*	writing skills	1	2	3	4	5	6	7	8	9	10
1												
2												
3												
4												
5												
6												
Comments												

Figure 1. Course design form for beginning the mapping process at the SU BJD School of Pharmacy

automate calculations and visualizations[4,6,9]. Hybrid collection methods also are possible.

METHODS

Mapping Tool

A preliminary electronic mapping tool was developed in Excel based on recommendations from instructional design and pharmacy education authors[1-5,7]. The tool was pilot tested on one course by the Academic Affairs Committee and two students who recently had completed the course. Subsequent content changes were made to the tool to include more data fields, to color-code sections, and to enable it to be printed and completed manually (with the understanding that hand-written answers must be transferred to the electronic form).

The tool includes a tab/form (Fig. 1) for course design. Course objectives are linked to Bloom's revised taxonomy, and quizzes, tests, and assignments are linked to course objectives. Another tab/form (Fig. 2) includes foundational science elements for pharmacists (Appendix B), recommended by the Accreditation Council of Pharmacy Education (ACPE) to be included throughout the curricula of all doctor of pharmacy programs. Each foundational element can be evaluated in terms of intended/enacted coverage (yes/no); coverage hours; coverage level (basic, intermediate, advanced); and learned coverage (poor, fair, adequate, good – based on student feedback). Each of these coverage descriptors is subdivided into different instructional delivery methods (e.g., one hour lecture, one hour lab).

A second tool (Fig. 3) was developed to compile components of all course mapping forms; this tool provides a program-level illustration of the recommended curriculum content coverage. Results are automated and color-coded to depict content coverage with and without inclusion of prerequisites and electives.

Data Collection

The Academic Affairs Committee, charged with curricular mapping, divided into member pairs and took responsibility for multiple P1 (first professional year) courses. Each pair was matched with two student and two faculty volunteers to assist in mapping the designated courses. Course coordinators were requested to complete the mapping forms independently. Results will be compared and reconciled in subsequent meetings between subcommittees and the course coordinators. The chairperson of the Academic Affairs Committee provided several optional training sessions on the mapping process, and a May 2009 deadline was given for P1 course mapping.

Coverage level data for each course is being extracted (copied) into the program-level mapping tool by the Director of Curriculum and Assessment as evaluation results are available. P1 course mapping will be finalized this fall, P2 courses will be completed by June 2010, P3 courses by June 2011, and P4 courses by June 2012. (Note: All curricula cannot be mapped simultaneously because a new curriculum was developed starting with the entering Class of 2012. It is being implemented each year as that class progresses.)

RESULTS

The forms were distributed and completed with only minor issues. The subcommittee mapping meetings and course-level mapping tool have uncovered duplicate lectures, small gaps in coverage, and objectives that need refinement. Further analysis of the completed forms will provide information about which courses require or hope to enhance critical thinking and writing skills. When all courses mappings are complete, the aggregate program-level mapping tool will provide a comprehensive look at the P1 curricular coverage level of the foundational science elements.

DISCUSSION

While comprehensive assessment products are ideal, fiscal restraints have required many institutions to find more budget-friendly methods and tools for gathering and analyzing assessment data. The mapping tools discussed

COURSE #: Course Name																				
#	Foundational Science Elements for Pharmacists	Intended/Enacted Coverage 0=No; 1=Yes				Intended Coverage Hours 15min=0.25, 20min=0.33, 30min=0.50, etc.				Coverage Level 1=Basic; 2=Intermediate; 3=Advanced				Learned Coverage* 1=Poor; 2=Fair; 3=Adequate; 4=Good				Numeric Coverage Level
		Lecture	Lab/Discuss	Asgnmnt	Other	Lecture	Lab/Discuss	Asgnmnt	Other	Lecture	Lab/Discuss	Asgnmnt	Other	Lecture	Lab/Discuss	Asgnmnt	Other	
A.	**Basic Biomedical Sciences**		0.0%				0.00				0.00				0.00			0.0
A1.	**Anatomy and Physiology**		0.0%				0.00				0.0				0.0			0.0
A1.1.	structure and function of major body systems: integumentary,																	0
A1.2.	molecular aspects of cell biology																	0
A1.3.	cell physiology and cellular structure and organization																	0
A2.	**Pathology/Pathophysiology**		0.0%				0.00				0.0				0.0			0.0
A2.1.	basic principles and mechanisms of disease, including:	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
A2.1.1.	inflammation and repair																	0
A2.1.2.	degeneration																	0
A2.1.3.	disturbances on hemodynamics																	0
A2.1.4.	developmental defects																	0
A2.1.5.	neoplasia																	0
A2.2.	pathophysiology of disease states amenable to pharmacist																	0
A3.	**Microbiology**		0.0%				0.00				0.0				0.0			0.0
A3.1.	general principles of microbial concepts																	0
A3.2.	principles of infectious disease																	0
A3.3.	host-parasite relationships																	0
A3.4.	pathogenic micro-organisms of man																	0
A3.5.	inflammatory responses to infectious agents																	0
A3.6.	clinical aspects of infection																	0
A4.	**Immunology**		0.0%				0.00				0.0				0.0			0.0
A4.1.	human immunity and immune response																	0
A4.2.	principles of antigen-antibody relationships																	0
A4.3.	molecular biology of immune response																	0
A4.4.	genetic basis for antibody synthesis, development, function, and immunopathology																	0
A5.	**Biochemistry/Biotechnology**		0.0%				0.00				0.0				0.0			0.0
A5.1.	chemistry of biomacromolecules (proteins, lipids, carbohydrates, and DNA)																	0
A5.2.	enzymology and co-enzymes and kinetics																	0
A5.3.	metabolic pathways to energy utilization																	0
A5.4.	nucleic acid metabolism, including DNA replication and repair, RNA, and protein synthesis																	0
A5.5.	recombinant DNA technology																	0
A6.	**Molecular Biology/Genetics**		0.0%				0.00				0.0				0.0			0.0
A6.1.	cell structure and components																	0
A6.2.	ion channels and receptor physiology																	0
A6.3.	mitosis and meiosis																	0
A6.4.	chromosomes and DNA																	0
A6.5.	gene transcription and translation processes																	0
A6.6.	recombinant DNA technology																	0
A7.	**Biostatistics**		0.0%				0.00				0.0				0.0			0.0
A7.1.	understanding of commonly used statistical tests and their basis																	0
A7.2.	management of data sets																	0
A7.3.	evaluation of statistical results																	0
A7.4.	understanding of statistical versus clinical significance																	0
B.	**Pharmaceutical Sciences**		0.0%				0.00				0.00				0.00			0.0
B1.	**Medicinal Chemistry**		0.0%				0.00				0.0				0.0			0.0
B.1.1.	physico-chemical properties of drug molecules in relation to drug absorption, distribution, metabolism, and excretion (ADME)																	0
B.1.2.	chemical basis of pharmacology and therapeutics																	0
B.1.3.	fundamental pharmacophores for drugs used to treat disease																	0
B.1.4.	structure activity relationships in relation to drug-target interactions																	0
B.1.5.	chemical pathways of drug metabolism																	0
B.1.6.	application to making drug therapy decisions																	0
B2.	**Pharmacology**		0.0%				0.00				0.0				0.0			0.0

Figure 2. Course-level mapping form for foundational science elements (page 1)

here are user friendly and appear to be good alternatives to commercial assessment software or online applications. The tools give a visual depiction of the course content and program status. Further calculations and statistics may be added to the forms in the near future. Though a complete picture of program status will not be available until after the third year, steps can be taken to remedy and refine content in the preceding professional year's curricula.

Students have provided invaluable feedback throughout the project. They are able to recall overlaps in the curriculum that may or may not be found by analyzing high-level evaluations which concentrate on specific items. Faculty have been enlightened by verbal student feedback and the formal mapping process, and most now recognize its value for assessment and accreditation. The mapping process also helps illustrate to faculty instructional design concepts that are sometimes overlooked in non-education-related higher education programs.

CONCLUSION

With accreditation standards' emphasis on instructional design and curricular mapping, participation in curricular mapping is becoming an assumed task for many higher education faculty. "Curriculum mapping and review is now an expected [and required] continuous quality improvement initiative of [doctor of pharmacy] programs."[4] Opportunities exist to train new faculty about instructional design processes, including curriculum mapping; this will help to ensure alignment between course objectives, evaluation methods, and course content. Program-level data, once compiled, will depict areas that may need improvement.

					Prerequisites																P1								
#	Foundational Science Elements for Pharmacists	Prereq + Elective	P1-P4	Status	English 101,&102	Public Speaking	Philo/Rel Or Ethics	Gen Bio I&	Cell/m Chem I&II	Organic Chem I&II	Physics I	Math	Calculus	Bio Science	Econ	Microbio	Human	Soc/Beh Science	501	502	503	504	505	506	507	508
A.	**Basic Biomedical Sciences**	0	0																							
A1.	**Anatomy and Physiology**	0	0																							
A1.1.	structure and function of major body systems: integumentary,	0	2																	1			1			
A1.2.	molecular aspects of cell biology	0	2																	1			1			
A1.3.	cell physiology and cellular structure and organization	0	1																				1			
A2.	**Pathology/Pathophysiology**	0	0																							
A2.1.	basic principles and mechanisms of disease, including:	0	2																	2						
A2.1.1.	inflammation and repair	0	3																	2	1					
A2.1.2.	degeneration	0	1																	1						
A2.1.3.	disturbances on hemodynamics	0	3																	1	2					
A2.1.4.	developmental defects	0	2																	2						
A2.1.5.	neoplasia	0	1																	1						
A2.2.	pathophysiology of disease states amenable to pharmacist	0	1																	1						
A3.	**Microbiology**	0	0																							
A3.1.	general principles of microbial concepts	0	0																							
A3.2.	principles of infectious disease	0	3																	2			1			
A3.3.	host-parasite relationships	0	0																							
A3.4.	pathogenic micro-organisms of man	0	3																	2			1			
A3.5.	inflammatory responses to infectious agents	0	0																							
A3.6.	clinical aspects of infection	0	3																	2			1			
A4.	**Immunology**	0	0																							
A4.1.	human immunity and immune response	0	0																							
A4.2.	principles of antigen-antibody relationships	0	3																	2			1			
A4.3.	molecular biology of immune response	0	1																		1					
A4.4.	genetic basis for antibody synthesis, development, function, and immunopathology	0	2																	2						
A5.	**Biochemistry/Biotechnology**	0	0																							
A5.1.	chemistry of biomacromolecules (proteins, lipids, carbohydrates, and DNA)	0	2																					2		
A5.2.	enzymology and co-enzymes and kinetics	0	0																							
A5.3.	metabolic pathways to energy utilization	0	0																							
A5.4.	nucleic acid metabolism, including DNA replication and repair, RNA, and protein synthesis	0	0																							
A5.5.	recombinant DNA technology	0	0																							
A6.	**Molecular Biology/Genetics**	0	0																							
A6.1.	cell structure and components	0	3																						3	
A6.2.	ion channels and receptor physiology	0	3																						3	
A6.3.	mitosis and meiosis	0	3																						3	
A6.4.	chromosomes and DNA	0	3																						3	
A6.5.	gene transcription and translation processes	0	3																						3	
A6.6.	recombinant DNA technology	0	3																						3	
A7.	**Biostatistics**	0	0																							
A7.1.	understanding of commonly used statistical tests and their basis	0	0																							
A7.2.	management of data sets	0	0																							
A7.3.	evaluation of statistical results	0	0																							
A7.4.	understanding of statistical versus clinical significance	0	0																							

Figure 3. Sample program-level mapping form for foundational science elements (page 1)

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