

## AACP REPORTS

### Cultivating ‘Habits of Mind’ in the Scholarly Pharmacy Clinician: Report of the 2011-12 Argus Commission

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#### INTRODUCTION

The American Association of Colleges of Pharmacy (AACP) Argus Commission is comprised of the five immediate past AACP presidents and is annually charged by the AACP President to examine one or more strategic questions related to pharmacy education often in the context of environmental scanning. Depending upon the specific charge, the President may appoint additional individuals to the Commission.

President Crabtree requested that the 2011-12 Argus Commission examine the following questions as part of his examination of critical issues of excellence and relevance in academic pharmacy:

- What is core with respect to the scientific foundation of clinical education?
- How and when do we teach this foundational material?
- How can we infuse an attitude of inquisitiveness and scholarly thinking in pharmacists and other health care professionals?
- How can we nurture emerging scientists among our students and young faculty?
- What ultimately will keep our graduates from being technicians vs. professional clinicians?

The work of the Argus Commission was advanced significantly by examining related reports and projects from outside pharmacy and from engaging in dialogue with education leaders across the health professions. When the Commission met in December 2011 they were joined by leaders from academic dentistry, allopathic and osteopathic medicine, nursing, optometry, physicians assistant, public health, veterinary medicine and health administration programs.

The meeting began with a presentation by Cynthia Bauerle, Ph.D., Senior Program Officer for PreCollege and Undergraduate Science Education at the Howard Hughes Medical Institute (HHMI) based in Chevy Chase,

MD. HHMI and the Association of American Medical Colleges have collaborated on several projects to ensure that the scientific foundation for physician education remains contemporary and strong. They jointly published the “Report of Scientific Foundations for Future Physicians Committee”<sup>1</sup> in 2009, which the Argus Commission considered carefully in its work.

Dr. Bauerle presented an on-going HHMI project referred to as the NEXUS Project<sup>2</sup>. The National Experiment in Undergraduate Science Education is relevant to all programs in health professions education which depend on the adequate undergraduate preparation of future clinical scientists in core competencies in mathematics, physics, chemistry and biology. This four year project which began in early 2010 involves grantees at four universities (Purdue University, University of Maryland College Park, University of Maryland Baltimore County and the University of Miami) and draws heavily upon the scientific foundations for future physicians report as the project teams work to significantly modify the pedagogical approach for teaching and assessing learning in the fundamental building blocks of science at the undergraduate level.

Throughout the full day meeting and subsequent analysis by the Argus Commission, participants acknowledged the continuum of learning and competency attainment so vital to ensuring that future pharmacists and colleagues across the spectrum of the health professions are inquisitive learners and problem solvers comfortable in applying both the scientific method and evidence-based content to the identification and resolution of clinical issues/problems at the individual patient and population levels. This begins far down the pipeline in pre-collegiate education and continues throughout the period of pre-professional and professional education with an ultimate goal of creating a scientific thinker with the requisite abilities to apply that knowledge in practice.

## THE ROLES OF PRE-PHARMACY EDUCATION IN DEVELOPING “HABITS OF MIND”

Boyce and Lawson<sup>3</sup> provided a contemporary analysis of and recommendations for preprofessional learning in their background paper for the AACP Curricular Change Summit. They noted positive changes in undergraduate education driven by “evidence-based educational research, the need to perform assessment, and results from national surveys on student engagement and satisfaction.” The trends in use of active and small group learning, interactive educational methods aimed at improving problem-solving, and technologically advanced learning both in and outside the classroom are all positive in preparing these learners for health professions education. They further document increased levels of extra- and co-curricular activities that emphasize abilities in social responsibility, empathy, teamwork, and leadership so critical to the development of professionalism for the clinicians.

The authors reviewed the available literature on correlates of academic success in the Doctor of Pharmacy degree program as well as the results of a survey from academic administrators examining appropriate preprofessional curriculum for student pharmacists. It remains clear that a record of strong academic performance and admissions tests results in core coursework in biology, chemistry and math are reliable predictors of strong academic performance in the pharmacy curriculum. There is more limited analysis of the impact of course work in the humanities and social sciences on the academic performance or professionalization of student pharmacists.

That said, the pre-pharmacy requirements vary widely across our various schools and colleges. As compiled annually as part of AACP’s Institutional Research Program, the total amount of pre-requisite courses vary from 41 to 91 semester hours and the years of pre-pharmacy vary from 2 to 4, with 30 programs preferring a B.S. or B.A. upon admission and 7 requiring a B.S. or B.A. We were unable to find data that reveal the correlation of the hours of pre-pharmacy pre-requisites to success on NAPLEX after graduation or any other measures of outcomes. The absence of data does not mean that there are no differences in academic performance or outcomes, but they are not obvious without additional investigation among schools.

The rapid expansion of relevant sciences and explosion of new knowledge becomes daunting in the context of time bound degree programs. Furthermore, a focus solely on the content of the scientific foundations poses the threat of overwhelming the inquisitiveness and problem solving abilities that are so desired in our health care professionals. The Argus Commission stayed away from

attempting to define any specific disciplinary content areas as essential to the pharmacy student or the graduate pharmacist, and rather focused on how the requisite skills that define the inquisitive and scholarly practitioner can be ensured.

The question arose: Can the multidimensional goal of 1) building a scientific foundation, 2) developing a foundation in the social and behavioral sciences, and 3) developing of an inquisitive mind and problem-solving abilities, be best achieved through a *layered* approach (in which the scientific foundations are initially built during the pre-pharmacy period, followed by a period of application in the pharmacy program), or an *integrated* approach which weaves basic biomedical and clinical science knowledge acquisition with appropriate application throughout the pharmacy curriculum? Several recent national analyses of medical and other health professions education approaches draw the conclusion that competency-based, technology-enhanced education that integrates content across disciplines and uses early and continuous active, simulated and experiential learning individualized to learner needs is the aspirational model for many levels of education, including pharmacy education at the doctoral level<sup>6</sup>.

The idea that some of the content of the foundational disciplines generally perceived as “pre-pharmacy” or “preprofessional” can also be integrated into the professional curriculum, provided that the students are prepared to acquire essential knowledge as it is needed, is not well-accepted. However, the explosion of new knowledge makes it unlikely that all contributory content can be acquired in the traditional pre-pharmacy curriculum, prior to matriculation into pharmacy school. This is especially evident when one examines the behavioral and social sciences which include twelve different contributory disciplines (sociology, psychology, anthropology, communications, political science, ethics, economics, linguistics, informatics, epidemiology, population sciences, languages and global studies) that make up the foundation of the learning outcomes defined for future physicians (and presumably, pharmacists)<sup>4</sup>.

The challenge of curricular overload and fatigue raises anew questions of what is “core” and what pedagogical approaches best enable our students to become inquisitive, life-long learners capable of recognizing when their current knowledge base is insufficient to resolve the problems that confront them. The answers to this challenge have broad implications for our admissions policies, our influence on pre-professional education at all of our “feeder” schools, our assessment methodology, and the extent to which foundational knowledge is incorporated into the professional curriculum.

There are changes beginning with K-12 educational models and undergraduate learning in higher education that will influence some or all of the learners admitted into the health professions. Marc Loudon, Gustav E. Cwalina Distinguished Professor of Medicinal Chemistry at Purdue University, is the NEXUS Project lead for the redesign of organic chemistry. He is also a leader in education reform activities at the American Chemical Society. In an interview with Dr. Loudon to learn more about the NEXUS Project he described how his approach to teaching and assessing learning of pre-pharmacy students in organic chemistry has evolved over the years and continues to change through his work on the NEXUS Project. Purdue is somewhat unique in that pharmacy faculty have taught the organic chemistry sequence for many years. Purdue also has placed a priority on maintaining a 2-year pre-pharmacy expectation, but consistent with many other schools sought to shift biochemistry into the pre-pharmacy curriculum. This led to a negotiation of expectations with the Chemistry department at Purdue regarding the need to compress general chemistry into a 1-semester course for biological science students, including the pre-health professional learners. The Argus Commission is pleased that Dr. Loudon will present an overview of the NEXUS Project and its implications for curriculum and assessment at the 2012 AACP Annual Meeting.

Learning from the Purdue experience, the Argus Commission recognized that accomplishing some of the changes on the horizon in pharmacy education will certainly require changes earlier in the education process. Consideration should be given to characterizing the need for changes in the pre-pharmacy portion of the educational process and AACP should find the appropriate means to communicate these expectations for change in the fundamental building blocks for health professions learners. The heterogeneity of applicants' learning experiences, technological fluency, and maturity of core skill development (e.g., critical thinking and problem solving) is an issue that merits attention.

Medical schools have developed competency frameworks to define the baseline skills and knowledge for their incoming students. The goal is to change the medical school admissions process so that there is much more emphasis on demonstration of a broad set of competencies and much, much less emphasis on completion of a defined set of pre-medical courses. The Argus Commission reviewed the 2009 report of AAMC and HHMI on the Scientific Foundations of Future Physicians<sup>1</sup> and specifically studied the two competency sets published in the report. Those competencies identified by the joint panel as entry level competencies that every pre-medical student should be expected to have mastered prior to entering medical

school were called E-competencies. The cross-cutting statement of abilities for all medical students included in the report was that pre-medical students should: demonstrate both the knowledge of and ability to use basic principles of mathematics and statistics, physics, chemistry, biochemistry and biology needed for the application of the sciences to human health and disease; demonstrate observational and analytical skills and the ability to apply those skills and principles to biological situations. The assessment of the Argus Commission members relative to the e-competencies was that they were equally applicable to pharmacy students and likely applied across all the health professions preparing doctoral-level clinicians.

A new Medical College Admission Test is under development (MCAT-5) and is designed to assess required knowledge and abilities for the incoming medical student as described above, regardless of the pre-medicine pathway the student has completed. A new section will be added to the MCAT for administration beginning in 2015<sup>5</sup>. "Psychological, Social, and Biological Foundations of Behavior," will test the ways in which these areas influence a variety of factors including people's perceptions and reactions to the world; behavior and behavior change; what people think about themselves and others; cultural and social differences that influence well-being; and the relationships among socio-economic factors, access to resources, and well-being. According to the representative from the medical colleges associations, many medical schools are dropping entirely the requirement for completion of a list of pre-requisite courses and are proposing to substitute the score on the future MCAT, which will measure competencies in both natural science and behavioral and social science areas.

### **Recommendation 1**

The Argus Commission recommends that specification of pre-pharmacy prerequisites be minimized in favor of the use of better assessment tools and that preference in admissions be given to pre-pharmacy experiences that develop an inquisitive mind in our entering students.

### **Recommendation 2**

The Argus Commission recommends that AACP identify opportunities to engage with national science organizations and associations of health professions advisors for discussion of the content and pedagogical approaches used for foundational coursework in the pre-pharmacy curriculum.

### **Recommendation 3**

The Argus Commission recommends that schools and colleges of pharmacy utilize additional assessments

of foundational knowledge and then structure learning such that students may acquire and reinforce content knowledge areas that may not be fully developed during their pre-pharmacy studies while they are completing the pharmacy curriculum.

#### **Recommendation 4**

The Argus Commission recommends that the PCAT Advisory Committee study in detail the MCAT 5 and subsequently lead the Academy in updating the PCAT to better reflect the new and emerging competencies; particular attention should be paid to the behavioral and social sciences.

### **THE ROLE OF THE PROFESSIONAL CURRICULUM IN CULTIVATING “HABITS OF MIND”**

President Crabtree’s core charges to the Argus Commission involved defining the core scientific foundation for pharmacy education, determining the optimal sequencing of foundational learning, and infusing a culture of inquisitiveness in our learners. Again, the Commission drew upon the work of AAMC and HHMI in approaching these charges. Another important resource was the report based on research by The Carnegie Foundation for the Advancement of Teaching on preparing the professions. The book, *Educating Physicians: A Call for Reform of Medical School and Residency*<sup>6</sup>, provided findings and recommendations based on interviews and site visits to a diverse subset of 11 medical schools and aimed to revisit the blueprint for medical education articulated by the 1910 report authored by Abraham Flexner. The Carnegie report recommends four goals for medical education: standardization of learning outcomes and individualization of the learning process; integration of formal content knowledge and clinical experience; development of habits of inquiry and innovation; and focus on professional identify formation.

#### **Competency Frameworks**

Pharmacy educators have numerous (and growing numbers of) competency frameworks to utilize in defining core domains of knowledge for learners. Appendix B of the 2007 Standards and Guidelines for the Pharm.D. Program as published by the Accreditation Council for Pharmacy Education explicitly defines required competencies across the pharmaceutical, clinical, social and administrative sciences. These were derived from discipline-specific elaboration on the three core competency domains published in 2004 by AACP as updated CAPE Educational Outcomes. A new CAPE Outcomes panel

began working in May 2012 and will produce a new competency framework in 2013.

The AAMC/HHMI scientific foundations report affirms eight specific domains as core to preparing a physician. The Argus Commission evaluated their relevance to pharmacy education and deemed all of the competency statements and many of the associated learning objectives germane to the Pharm.D. program. They specifically appreciated this preface to the listing of competencies and objectives:

The shift from defining required courses to articulating competencies is becoming increasingly widespread in education<sup>7</sup>. In a seminal article in 2002, Hundert and Epstein<sup>8</sup> reviewed work done on achieving competency and established a definition of competency that is widely accepted in medical education: “Competency is the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and the community being served.” Competence develops over time, and as competence is nurtured by reflection on experiences, it becomes a habit. Previously, in an article in the *Journal of the American Medical Association* (JAMA) in 1999, Epstein wrote about the concept of mindfulness and its importance in developing competence<sup>9</sup>. He argues that competence depends on habits of mind that allow the practitioner to be attentive, curious, self-aware, and willing to recognize and correct errors. Competencies are specific learned abilities that the practitioner has adopted as a consequence of his or her education.<sup>1</sup>

A paper published in 2002 by Lee S. Shulman<sup>10</sup> offers insights into “A Table of Learning” that is pertinent to the questions posed to the Argus Commission. The table includes the following elements/levels:

- Engagement and motivation
- Knowledge and understanding
- Performance and action
- Reflection and critique
- Judgment and design
- Commitment and identity

Dr. Shulman warned educators against the natural temptation to believe that one must begin an educational process at the top of the list and move sequentially “up” the chain of learning complexity. He presents several graphical representations of the concepts as cyclical and interacting constructs (e.g., might one need commitment to become an engaged learner or does understanding advance through performance and action). This underscores the importance of introducing practice application into the professional curriculum early and continuously and places appropriate emphasis on the skills of reflective learning as well.

### **Contemporary Learning Models to Achieve “Habits of Mind”**

The availability of so many compelling competency frameworks, which now include competencies for interprofessional education,<sup>11</sup> as well as the behavioral and social science foundations for future physicians as published in November 2011 by AAMC<sup>4</sup>, challenged the Argus Commission to define the “core scientific foundation for clinical education”. Similarly, the expanding body of scientific and clinical knowledge and the rapidity of change in our understanding of the most appropriate application of this knowledge to an individual patient or population demands that pharmacy faculty continue implementing evidence-based approaches to changes in education. Specifically, our curricula should include integrated learning that combines basic and clinical sciences with humanistic studies; technology-mediated learning that provides opportunities for self-paced acquisition of core knowledge coupled with individual and small group application exercises; simulation; and early and continuous experiential education across multiple practice environments where students can see experienced practitioners model the delivery of quality patient care and can engage in direct patient care activities.

In 2011, the AACP School Poster invited schools to share their work in Integrating Basic and Clinical Sciences Education. A review of the poster abstracts published in the *American Journal of Pharmaceutical Education* reveals the substantial implementation of integrated models of learning and specifically the integration of core basic and clinical science instruction in modular, team-taught courses. In many cases this integration occurred in multi-year course sequences and also influenced the design of pharmacy skills laboratory courses as well as introduced capstone courses into pharmacy curricula.

The Argus Commission believes that the integrated curriculum encourages students to make linkages between pieces of information from various disciplines and encourages learning of content as it is needed. It is one factor in creating an inquisitive and scholarly thinking pharmacist. Secondly, we believe it is essential that students be immersed in a culture of scholarship as exemplified by faculty engaging in scholarly activity and delivering evidence-based education. Developing research skills in students is a third important contribution to developing pharmacists with the attributes we seek.

The culture of scholarship requires that faculty be engaged in research and scholarly activity, including doing research and disseminating results on optimal teaching methodology. According to a paper by Benevides and colleagues, pharmacy faculty as a whole are not very

productive as measured by publications.<sup>12</sup> The 50th percentile of publications for all faculty as defined by the American Association of University Professors (AAUP) is 0.87 per year. For pharmacy faculty, the 50th percentile is 0.6 publications per year or 1 publication every 1.7 years. It varies somewhat between public and private schools and is increased for faculty whose school has some NIH funding, but it is hard to say that pharmacy faculty are highly engaged in research as measured by its dissemination.

ACPE has standards and guidelines that state that a college/school must “have a sufficient number of qualified full-time faculty and staff to effectively deliver and evaluate the professional degree program, while providing adequate time for faculty development, research and other scholarly activities, service and pharmacy practice” and the standard on faculty scholarship says that pharmacy faculty members “should generate and disseminate knowledge through scholarship”. The Argus Commission believes that these standards should be enforced if we are to have a culture of scholarship in each of our schools.

### **Recommendation 5**

The Argus Commission recommends that AACP work with ACPE to ensure that standards relevant to research and scholarship among our faculty be measured and enforced.

### **Recommendation 6**

The Argus Commission recommends that AACP include in its faculty development activities additional emphasis on enhancing scholarly activities across the spectrum of areas of research.

Equally important may be the sharing of that culture of scholarship and the excitement of discovery, as well as research skills, with students by requiring that students engage in a research project and prepare a subsequent paper and/or presentation. An article by Murphy and colleagues<sup>13</sup> studies the prevalence of research paper requirements in our schools and colleges and a viewpoint paper by Frank Ascione<sup>14</sup> provides an example of a school with a 40+ year old research requirement and the positive outcomes he has observed from this requirement. Murphy, et al found that most schools (> 90%) required students to complete courses in biostatistics and drug information/literature evaluation. Twenty-five percent required some form of project.

A recently published article from faculty at the University of California, San Francisco examined important elements of requiring a research project for graduates.<sup>15</sup> Authors sought input from students’ research preceptors regarding the value of the outputs of the research

project and affirmation of whether the work had been disseminated. While only a small number of projects were published in the peer-reviewed literature, preceptors nonetheless believed there is value for both the learner and the organization for such projects, including stimulating creative thinking and problem solving abilities in graduates. A more in depth study of the outcomes of these requirements on the inquisitiveness and scholarly thinking of the graduates is lacking, but the generally held opinion is that it has value for motivated students.

Argus Commission member Victor Yanchick, Dean of the Virginia Commonwealth University School of Pharmacy, shared a curricular innovation introduced at his institution several years ago that threads a focus on scholarly activities aimed at achieving inquisitiveness in all graduates. Students begin learning skills associated with scholarly activities in the very first semester by producing a poster. A 4-credit sequence of coursework across the P-2 and P-3 years expose students to the broad range of research in the pharmaceutical and clinical sciences and further the development of scholarly competencies through didactic, small group and active learning activities. Emphasis is placed on the responsible conduct of research and all students develop a research or quality improvement project proposal.

The experiential components of the Doctor of Pharmacy curriculum provide an ideal opportunity for students to master the inquisitive characteristics of a scientific thinker. Real world cases addressing patient care and practice management challenges demand routine application of the sciences. Integration of scientific backgrounds into solving complex patient care problems can be strengthened by articulating competencies explicitly addressing the application of the basic sciences. For example, an increased emphasis on medication use systems and the emerging regulatory, safety, advanced biostatistics and informatics will complement the more common disease state focus of experiential education. Students will be especially challenged to analyze the trends in health care technology advances from both a single patient and systems perspective.

There are opportunities to develop scholarly thinking in graduates enrolled in dual degree programs as well. Whether in business, public health, law, or pharmaceutical/clinical sciences, dual degree programs often include case based learning, scholarly papers and research projects. The 2010 report of the Research and Graduate Affairs Committee provides a contemporary examination of such programs.<sup>16</sup>

The Argus Commission also recognized that several extracurricular activities engage students in important skill development processes. Coordinated by national

organizations in many cases, student pharmacists participate in the National Patient Counseling Competition (APhA -[www.pharmacist.com](http://www.pharmacist.com)), the Clinical Skills Competition (ASHP – [www.ashp.org](http://www.ashp.org)), the GNP Pruitt-Schutte Student Business Plan Competition (NCPA – [www.ncpanet.org](http://www.ncpanet.org)), the Clinical Pharmacy Challenge (ACCP – [www.accp.com](http://www.accp.com)), the P&T Competition (AMCP – [www.amcp.org](http://www.amcp.org)) and interprofessional competitions such as the CLARION Competition ([www.chip.umn.edu/clarion](http://www.chip.umn.edu/clarion)). In some cases, participation in preliminary rounds of these competitions is incorporated into required or elective courses.

There has also been work conducted within pharmacy and in an interprofessional collaboration related to the assessment of professionalism in health professions learners. Kelley et al<sup>17</sup> will be presented the Rufus A. Lyman Award in July 2012 for the best published paper in the *Journal* in 2011 for their work to cross-validate an instrument for measuring professionalism behaviors in student pharmacists. A multi-profession collaborative, to which AACP members and staff have contributed, has an assessment instrument for measuring professionalism in an interprofessional context in the field for validation at this time. More information on this work is available at the IPC website: <http://interprofessionalprofessionalism.weebly.com/>.

To the extent that professionalism is cross-correlated with inquisitiveness and a scholarly approach to the profession, this instrument may be useful for measuring what factors (faculty modeling of scholarship, student research requirements, extracurricular projects) are most important in creating the “habits of mind” we seek.

### **Recommendation 7**

Colleges and schools of pharmacy should identify the most effective validated assessments of inquisitiveness, critical thinking, and professionalism to include as part of their assessment plans, for use as both admissions assessments and as measurement of curricular outcomes.

### **Disruptive Innovation in Higher Education: Faculty Development Needs and Implications**

There is unequivocal evidence of change in education across the entire continuum of learning. A recently published meta-analysis concluded that “on average, students in online learning conditions performed modestly better than those receiving face-to-face instruction,” with larger effects if the online learning was combined with face-to-face instruction<sup>18</sup>. On balance, the pharmacy education literature affirms that some pharmacy educators have applied the evidence from the educational literature

to advance from traditional faculty-centric curricular design and learning principles to more contemporary integrated, applied and learner-centric education. However, uneven incorporation of such pedagogical approaches, curricular overload, and immature assessment tools and techniques combine to create concern about whether sufficient progress has yet been achieved across the enterprise.

Pharmacy education is not alone. Frustration with the cost, effectiveness and slow pace of change in higher education has been voiced repeatedly, especially in the past several years of significant economic distress in the United States and around the world. Harvard Business School professor Clayton Christensen has applied theories of disruptive innovation to education, drawing upon his earlier analyses of innovation in computing technology, health care and other fields. From a white paper published in February 2011 jointly by the Center for American Progress and the Innosight Institute, a consulting firm created by Dr. Christensen:

Disruptive innovation is the process by which a sector that has previously served only a limited few because its products and services were complicated, expensive, and inaccessible, is transformed into one whose products and services are simple, affordable, and convenient and serves many no matter their wealth or expertise. The new innovation does so by redefining quality in a simple and often disparaged application at first and then gradually improves such that it takes more and more market share over time as it becomes able to tackle more complicated problems<sup>19</sup>.

Christensen and colleagues believe that education is ripe for the kinds of disruptive innovation that has transformed computing technology over the last 50 years. It will be the effective use of technology-enhanced learning and assessment strategies that will transform education at all levels, including higher education. Whether traditional universities with their broad missions and inefficient operations can adapt quickly enough to remain competitive is a provocative question. The authors believe it will be very difficult for the typical educational institution to do so as disruption is rarely successfully introduced by the predominant players in an industry that is experiencing significant change.

Blouin and colleagues described the roles of innovation in education delivery in a review article prepared for the AACP Curricular Change Summit.<sup>20</sup> Citing many of the same forces of change as the paper on disruptive innovation, the authors document the use of technology and related educational innovations and ask serious questions regarding how well equipped pharmacy educators are to effectively utilize available and

emerging learning technologies in a manner that truly enhances student learning to achieve our goals of producing a critical, practical and creative thinker prepared to meet society's needs for a 21st century medication use specialist.

In the paper's concluding paragraph the authors write:

The question arises, are faculty members and institutions ready to take advantage [of the digital revolution]? We should not jump headfirst into this potential digital cauldron without taking stock of an important detail which is shared with all technologies and instructional practices: we must not only understand their potential to impact deeper learning in students, we must also understand their limitations as a means to achieve deeper learning. It is not the lecture, cooperative learning, or the problem-based method itself that enhances student learning any more than it is the Internet, podcasts, or simulations. It is far more important to know how to use the instructional methods and technology to support learning outcomes that are integrally linked to the student learner as a critical, practical, and creative thinker.<sup>20</sup>

Perhaps the way that disruptive innovation can best be applied in creating the graduates that have scholarly, inquisitive habits of mind is to use technology liberally in loosening up both pharmacy prerequisites and professional school requirements by permitting a more flexible acquisition of knowledge and skills, both in the pre-pharmacy period and in the professional program. Technology permits a just-in-time assessment and if needed, provision or reinforcement of knowledge and skills that are prerequisite for any given unit of instruction. It also permits students to reorder learning as needed and to review material when needed for application. Individualized assessment tools that are technology-based are critical for this process to succeed. This approach would truly be disruptive to the lock-step curricula we traditionally face but it may well encourage creativity, life-long learning and ongoing self-assessment of knowledge and skills. An embracing of innovation by faculty and accreditors alike, as well as students, would be essential to the implementation of such a disruptive innovation, but the benefits could be very large.

### **Recommendation 8**

AACP should provide programs and resources to assist pharmacy colleges and schools with implementation of new learning models that meet the needs of contemporary learners. Programs must evaluate both the impact on learning and the cost-effectiveness of curricular innovations, especially those that are technology-based.

### Recommendation 9

The Argus Commission recommends that course design should involve a team of experts including content experts, instructional designers, cognitive scientists, and curriculum and assessment experts with additional input from publishers and/or software vendors.

### Recommendation 10

AACP and member institutions should explore innovations in higher education and the scholarship of teaching in new learning environments and curricular delivery models to determine the applicability of these initiatives to pharmacy education.

### CONCLUSION

The charges from President Crabtree were timely and reflect shared concerns across the education continuum, including those of other health professions educators. Education experts seem to have reached consensus that blended models of learning that optimize digital access to content and provides learners continuous opportunities to apply knowledge in active learning and reflection is most effective. The timing of content acquisition seems secondary to the approach to learning. Assessment that is formative and embedded in the learning process is paramount and much additional work on the development and most effective use of assessment tools and strategies is essential. Progress will require a commitment to faculty development, shared educational and assessment resource creation, and additional educational scholarship to evaluate the impact of changes in education on learner outcomes and the cost effectiveness of our educational models.

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