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The Effect Of A Problem-Based Learning Curriculum On Performance On The Physician Assistant National Certifying Examination

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THE EFFECT OF A PROBLEM-BASED LEARNING CURRICULUM ON PERFORMANCE ON THE PHYSICIAN ASSISTANT NATIONAL CERTIFYING EXAMINATION

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Chapter I

Introduction

Problem-based learning (PBL) is a curricular innovation that has been growing in acceptance for the past 30 years. The innovation took root in medical schools, spread to nursing and allied health education programs, and has now been implemented in disciplines as diverse as undergraduate sciences (Shelton & Smith, 1998), business (Allen & Rooney, 1998), and economics (Maxwell, Bellisimo, & Mergendoller, 2001). However, acceptance of this curriculum is not universal; PBL has its vocal critics as well. Recent literature has been critical of the small effect size of PBL curricular interventions in the education of medical students (Colliver, 2000b). Defenders insist that PBL is not a monolithic educational intervention and varied approaches cannot be combined in an assessment of an aggregate effect size (Barrows, 1986; Harden & Davis, 1999; Margetson, 1998). Research to date has neglected to examine the actual activities encountered in a PBL experience, which is the "pivotal mediating process" (Hak & Maguire, 2000, p. 772). Prior to any assessment of the effect of PBL interventions, efforts must be made to look into this "black box" of PBL to clarify its definition and describe precisely what transpires in a PBL classroom.

Such a critical evaluation of the utilization and effect of PBL curricula in the physician assistant universe has not been done (Allison, 2000). The survey research presented here will provide a more precise definition of PBL as practiced by physician assistant programs in the United States. Statistical analysis of scores on the Physician Assistant National Certifying Examination (PANCE) will determine whether there is a statistically significant positive effect on mean program PANCE scores attributable to high levels of PBL activity.

Statement of Purpose

It was the purpose of this study to determine what activities are being undertaken in physician assistant programs that can correctly be termed "problem based learning." The extent to which PA programs have implemented problem-based learning in the delivery of their curriculum will also be measured. Lastly, an evaluation will be made as to the effect of problem-based learning in educational achievement as measured by mean scores and pass rates on the Physician Assistant National Certifying Examination (PANCE).

Significance of the Study

A critical look at problem-based learning is warranted for physician assistant educators, just as recent criticism and debate has informed the opinions of educators in medical schools. Linda Allison, a proponent of PBL in physician assistant education, admitted that there has been no comprehensive research into the current state of problem-based learning in PA education (Allison, 2000). This research is vital to the physician assistant profession. For years, PBL has been a "buzzword" for PA educators. If one is to determine whether PBL in PA education is a fad or a foundational instructional practice, a critical assessment must be made. Jerry Colliver has advanced his thoughtful criticism of medical school PBL activity in recently published letter

(Colliver, 2000a). It is hoped that a similar dialogue may benefit educational programs for physician assistants and the profession as a whole.

Statement of the Research Problems and Hypothesis

Problem-based learning (PBL) has been increasingly used in physician assistant educational programs. What is the current level of utilization of PBL in the universe of physician assistant education? How has this curricular change affected academic achievement, as measured by performance on the Physician Assistant National Certifying Examination (PANCE)?

The null hypothesis under investigation stated that the level of PBL activity in the curriculum of physician assistant programs is associated with no significant difference in educational achievement. Rejection of this null hypothesis will likely result in acceptance of an alternative hypothesis asserting that high-PBL physician assistant programs will have statistically significant higher academic achievement than lower-PBL physician assistant programs.

Organization of the Study

Chapter 1 serves as an introduction to the investigation. Chapter 2 discusses the relevant literature and theoretical underpinnings of the study. Chapter 3 presents the methodology of the study including the development of the survey instrument and the means of data analysis. Chapter 4 reveals the findings of the study. Chapter 5 concludes the investigation with a critical discussion of the findings, including limitations of the study and implications for future investigation.

Problem-based Learning and the Health Professions

This investigation focused on problem-based learning in physician assistant education; however, the relevance and value of this research is best appreciated in the broader context of health professions education as well as post-secondary education in general. Problem-based learning began in medical schools, and has supplemented or taken the place of traditional lecture-based curricula at more than 60 medical schools worldwide (Sweeney, 1999).

The first medical school to develop this curriculum was McMaster University in Ontario, Canada in 1969. Taking its cue from 1950s efforts at Case Western Reserve University School of Medicine to integrate various disciplines of the preclinical curriculum, the then-new medical school of McMaster University was the first to incorporate the student-centered, interdisciplinary methods of problem-based learning into the entire medical school curriculum (Lee & Kwan, 1999).

Several other medical schools in Canada and the United States followed McMaster in this pedagogical experiment, including Wake Forest University, the University of New Mexico, Michigan State University, Bowman Gray, Rush, Tufts, Southern Illinois University, and Harvard University (which brought PBL not only to its medical school but to its business school as well). Internationally, PBL has been used in medical education in Australia, Bahrain, Brazil, Chile, Egypt, Great Britain, Hong Kong, Indonesia, Malaysia, the Netherlands, Nigeria, the Philippines, Sweden, Switzerland, and Taiwan (Lee & Kwan, 1999).

Other health professions such as nursing, physical therapy and physician assistant programs have adapted some aspects of the PBL model for their curricula. These are most often undertaken in programs affiliated with a medical school with resources already committed to PBL, for example, the physician assistant program at Southern Illinois University and the physical therapy program affiliated with McMaster (Saarinen-Rahiika, Binkley, & Hayes, 1998).

Physician assistant programs across the country have been quick to adopt various types of PBL activities as a complement to traditional instructional methods; however, a curriculum based solely on PBL remains rare in the allied health professions. Programs can be stratified into high-, medium-, and low-PBL programs. This differentiation would reflect PBL use as the modal means of instruction, or its use in supplementation or reinforcement of traditional lecture-based education. Linda Allison, program director of the Chatham College PA Program, estimated that there are no more than five physician assistant programs of the accredited programs nationwide that have curricula comprised of 90% or higher levels of PBL activities (Allison, 2000). Research into the online catalogues of PA programs revealed at least five programs (Southern Illinois University, Chatham College, Northeastern University, Western Michigan University, and University of New Mexico) that claim to deliver the majority of their course content through PBL methods.

High-PBL programs implement problem-based learning in various ways, giving credence to Hak's notion that one must peer into the black box to truly understand the curricular intervention being referred to as problem-based learning (Hak & Maguire, 2000). Southern Illinois University originated Problem-Based Learning Modules

(PBLM), which are detailed patient simulations written in a spiral-bound book. Students explore the patient's problem based on the "medical history" they choose to ask and the "physical exam" they elect to perform. Answers to their questions, even physical exam findings are supplied in a spiral-bound book once the student appreciates the need of the information and requests it. Their curriculum is almost entirely delivered through the use of these PBLMs. The cases are designed to deliver planned curricular content, yet allow for free inquiry and student-driven learning. Interestingly, SIU offer these self-contained modules for sale to other programs in lieu of independent development of their own PBL curricula (SIU Board of Trustees 2004). The Chatham College PA Program mentions use of the SIU modules in descriptions of their PBL curriculum (Biearman 2004).

The University of New Mexico Health Sciences Center offers the Partnerships for Training (PFT) curriculum, an interdisciplinary, community-based Problem-Based Learning (PBL) model for the training of nurse practitioners, nurse midwives, physicians and physician assistants. They recruited students from the geographic areas of the Portales, Espanola, and Gallup communities, train them in local health care facilities using actual clinical cases and settings, and return them to practice in the same community. Interdisciplinary PBL is supplemented by a few isolated discipline-specific lecture based courses (University of New Mexico, 2004).

Western Michigan University offers a PBL track to a small subset of its admitted PA students, as an alternative to a concurrently run traditional lecture-based curriculum. Up to eight students may elect to pursue this track, which includes facilitated small group work and student-centered learning objectives. Both curricular tracks are 2 years long, and the two tracks graduate at the same time (Western Michigan University, 2004).

PA programs that mention PBL in their curricula, but assign it a much less central role in content delivery include the programs of Southwestern Missouri State University, Butler University, the University of Texas, Baylor, Touro, and Seton Hill College. These could be considered low-PBL programs since the majority of the curriculum is delivered through more traditional means. PBL remains an adjunct activity, a sort of problem-based recitation or summation of material received largely through more traditional means.

Every PA program curriculum across the country includes clinical rotations for senior students, and this could be considered problem-based learning by some definitions. This appellation is even more appropriate to clinical rotations when testing and other student assessment is done through modalities such as objective simulated clinical experiences (OSCEs). The discussion here will be limited to PBL in preclinical or didactic-phase education, which does not always include patient contact. This distinction will avoid the confounding factor of every program construing senior clinical clerkships as problem-based learning.

Defining PBL

Barrows (1986) has referred to problem-based learning as "a genus for which there are many species and subspecies" (p. 485). Cases may be well organized and complete as supplied by the instructor, or a more vague problem statement can be supplied which leads to free student inquiry. There may be teacher-directed learning, student-directed learning, or a mix of the two. In Barrows' taxonomy, even the most structured content in lecture-based instruction, which incorporates carefully planned illustrative cases, is grouped into problem-based learning. Using such a broad definition of PBL, it would be hard to imagine a single medical education program that does not incorporate it to some degree. A meaningful investigation into the curricular design of true PBL will require a clearer definition.

Harden and Davis have developed a definition of PBL as 11 points along a continuum (Harden & Davis, 1999, see also Figure 4). The 11 steps move from a focus on concepts and rules to one of examples and illustrations. Steps along the continuum involve qualitative as well as quantitative changes in content, moving from information orientation to a problem-solving orientation. Lectures supplemented with clinical examples appear at one end of their continuum, while curricula delivered entirely through student-driven experiential learning appear at the other end.

The steps are: (a) theoretical learning, with emphasis on teaching and the acquisition of theoretical knowledge such as the traditional lecture; (b) problem-oriented learning, which is lecture-based with a more practical emphasis; (c) problem-assisted learning, which adds planned opportunities to apply practical knowledge such as clinical observation on hospital wards; (d) problem-solving learning, problem solving without placement into a broad context; (e) problem-focused learning, where problem solving may be preceded by an introductory lecture and is often followed by a discussion of the relevant principles and concepts; (f) problem-based mixed approach, where it is the student's choice to either begin with a problem or a traditional lecture; (g) problem-initiated learning, in which a problem is a trigger designed to arouse student interest and inquiry; (h) problem-centered learning, in which the problem is the central focus of the student's learning of principles and rules; (i) problem-based discovery learning, in which the students develop for themselves the principles and rules to be learned; (j) problem-based learning, in which generalization of the solved problem to other areas of inquiry is key; and (k) task-based learning, in which the focus for learning is no longer a simulated patient but the tasks that are performed by a typical graduate of the educational program. This last type most closely resembles internships and clinical residency programs.

The precision, clarity, and detail in the Harden and Davis (1999) typology is appealing, and has been incorporated into the survey research presented here.

Supporters and Detractors of PBL

Problem-based learning was developed for medical education, and medical schools most fully utilize this strategy. New schools have designed their curricula around it, and existing schools have revised their curricula to include it (Harden & Davis, 1999). There are some that take a very hard line approach to defining PBL. Margetson defined *conception I* (cI) of PBL as a case-based traditional curriculum, which merely adds the discussion of a clinical case as a "convenient peg on which to hang knowledge acquisition" (para. 12). *Conception II* (cII) of PBL involves a "growing web" (para. 25) of student understanding in which the successful solving of clinical problems is integral to learning. Margetson believes that cII is the only true member of the PBL genus. Conception I is at best a transitional phase to true PBL, "partly trapped in a discredited conception of learning." Any attempt to combine cII with cI is in his view, a muddying of the concept (Margetson, 1998, para. 29).

Proponents claimed that learning is better retained, retrieved, and applied when it occurs in a clinical context. Students trained in a problem-based learning curriculum showed enhanced problem solving and clinical reasoning skills, greater self-directed learning styles, a higher level of satisfaction with their medical education, a more holistic approach to the patient, and a greater likelihood to establish a practice in rural and underserved areas. The material learned is also inherently current when students avoid outdated texts in favor of primary resources (Saarinen-Rahiika et al., 1998).

Critics of PBL said that it is an inefficient way to learn preclinical basic sciences such as anatomy that rely heavily on memorization of factual information. Other criticism has brought attention to the high cost and high resource utilization of a problem-based curriculum. Several different models are grouped under the generic term of problem-based learning, and any discussion of a particular educational endeavor must make these distinctions clear.

Howard S. Barrows, a prominent researcher in problem-based learning at Southern Illinois University, encapsulated both pro and con positions. To a casual observer, the problem-based learning method might seem overly intuitive, unstructured, or even inefficient. Upon closer inspection, it is complex, carefully designed, structured, and efficient, with a sound basis in cognitive and educational psychology (Barrows, 1985).

Perhaps the harshest critic in the literature to date is Jerry Colliver of the Division of Statistics and Research Consulting of Southern Illinois School of Medicine. His literature review critically analyzed studies of problem-based learning in medical education. He found eight studies since 1993 that compared students in a PBL track to students in a traditional track. To provide a means to evaluate PBL curricula, he adapted the research of Benjamin Bloom regarding effect sizes of instructional methods. Bloom proposed that the most intensive educational treatment one could imagine, one-on-one tutoring, would have the maximal effect size. Any other instructional method would approach this ideal to varying degrees. Bloom's studies at the University of Chicago found an effect size in one-to-one tutoring of approximately $d = 2.0$, or two standard deviations above the standard mean (Bloom, 1984). Colliver asserted that the minimum acceptable level of effect size for a "major" curricular innovation is set at $d = 0.8$ to 1.0. He did not find any effect size approaching this level in problem-based learning, a curricular development largely regarded as major by other educators (Colliver, 2000b).

Colliver's main critique was that PBL students perform well in problem-based outcome measures such as preceptor evaluations and simulated patients. They do not suffer as a result of the new curriculum, but he considered none of these effect sizes as significantly positive. He expected more, given the massive resources typically devoted to PBL instructional methods. It was interesting to note that Colliver was based at Southern Illinois University School of Medicine, an originating institution of problem-based medical education in the United States. Colliver himself recognized the heavy commitment of resources required by a high-PBL curriculum. Given this investment of resources, it would be difficult for SIU or any other institution to heed his advice, forfeit the sunk costs, and abandon PBL entirely after a critical second look.

Rather than abandon PBL outright due to its perceived flaws, several medical schools have created hybrid educational methodologies that incorporate some aspect of PBL. Some, such as the Otago Medical School in New Zealand, found resistance from faculty who wished to teach in traditional ways. Their solution was a hybrid methodology called systems integration. Although case-based tutorials remained a major teaching modality, the Otago program differs from classical PBL in several ways. There is tighter direction of student activities, specialist sessions which often take the form of traditional lectures, formal learning objectives prepared by instructional staff, and detailed feedback provided to students. Faculty previously resistant to PBL were more accepting of this hybrid (Miller, Schwartz, & Loten, 2000).

A similar compromise was reached at Michigan State University's College of Human Medicine. Problem-based learning was desired, for it was believed that it was well suited to their emphasis on psychosocial aspects of medicine. Faculty at MSU-CHM decided that a year of foundational basic science education should be taught in a traditional manner and should precede PBL. Their hybrid solution involved limiting problem based learning activities to the second year of the medical school curriculum (Doig & Werner, 2000).

The Dialogue Since Colliver's Literature Review

Colliver's article has caused controversy in the pages of *Medical Education, Academic Medicine*, and related journals. Researchers dissected and challenged his findings, and even motivated Colliver to a rebuttal in a later issue of Medical Education (Colliver, 2000a). Albanese believed that Colliver's expectation of such a large effect size is unreasonable, requiring massive movement in student achievement measures across several quartiles. Albanese also felt that the medical school population has largely been selected for its success in traditional curricula throughout undergraduate educational experiences, and this may be a distracting factor causing lack of acceptance or success in a new and innovative way of learning (Albanese, 2000).

Norman and Schmidt (2000) differed with Colliver on two major points. Ceding the fact that effect sizes were small in the published literature, Norman and Schmidt felt that PBL is "more challenging, motivating, and enjoyable" than traditional curricula, and these subjective criteria may be enough to justify its existence (p. 727). Furthermore, they again faulted researchers for a lack of specifics as to what actually happens in the classroom, and they advocated future rigorous experimental designs as well as evaluations of existing programs to account for all variables (Norman & Schmidt, 2000).

Colliver's (2000b) response asserted his concern that PBL creates an environment which "turns educational practice away from constructing the elaborate conceptualizations of the basic sciences" and towards what he calls "fragmented conceptualizations." (p. 960). He also justified his expectation of effect size by reminding us that much should be expected of an innovation which has become so pervasive and purports to have enormous benefit (Colliver, 2000a).

This has clearly been a stimulating and thought-provoking dialogue in the literature on medical student education. There has been no comparable comprehensive study of PBL in physician assistant education. A valid investigation into the curricular impact of true PBL in the realm of PA education will require a precise definition of PBL such as that proposed by Harden and Davis (1999). It will also require a standardized outcome measure such as the United States Medical Licensing Examination (USMLE) identified as a common outcome variable by Colliver in his literature review. The Physician Assistant National Certifying Examination (PANCE) is the logical choice for the PA realm. It is hoped that following this study, a similar vigorous discussion may ensue in the physician assistant literature.

Chapter II

Literature Review

The term buzzword has been aptly used to describe practitioners' attitudes concerning problem-based learning. From the beginning, it seemed intuitive that this new technology was the solution to several problems within medical education. It was student-centered rather than instructor-centered. It seemed to positively influence interpersonal dynamics and foster critical thinking skills. It was experiential and evidence-based learning, for greater transfer of learning as the student becomes a caregiver. The "buzz" was indeed hard to ignore, and many professional educational programs adopted the new technology without requiring evidence of successful outcomes.

Once the buzz dies down, however, responsible educators are obliged to consider the facts and seek to demonstrate significant improvement in outcomes.

Over the centuries, there have been many curricular debates in American higher education. Problem-based learning, though decades old, is a relative newcomer. However, PBL fits well into any consideration of the development of postsecondary curriculum as a whole. Stark and Lattuca (1997) listed five main curriculum debates that have occurred in American higher education. Problem-based learning could be viewed as a point of departure in any one of these debates. The five debates as framed by Stark and Lattuca were: (a) educational purpose (general versus specialty education), (b) diversity of learners, (c) curricular content (prescription versus choice), (d) instructional process, and (e) evaluation and adjustment (Stark & Lattuca, 1997).

The higher education establishment has not held a single monolithic opinion in any of these debates. On the contrary, popular sentiment has often vacillated between dichotomous extremes over the centuries. In considering the prevailing opinions in the late 20th and early 21st centuries, problem-based learning may be taken as a case in point for many contemporary discussions.

The Debate over Educational Purpose

Stark and Lattuca (1997) framed the debate concerning educational purpose in terms of general versus specialty education. Higher education has seen advocates for both a classically broad liberal arts education and a utilitarian and practical course of study. Professional fields such as medicine, law, and business developed and strengthened in the early 20th century. Abraham Flexner's report on medical education for the Carnegie Foundation for the Advancement of Teaching fostered the growth of teaching hospitals and university-based medical education (Flexner, 1910). The American Medical Association was the first of the discipline-oriented associations imposing their "hidden hand" on the medical school curriculum (Altbach 1999). These were necessary first steps in the strengthening of medicine as a professional field of study. It is interesting that problem-based learning first came to light in this environment.

The late 20th century was characterized by a move to utility and career-related study. From the 1950s to the 1970s, veterans seeking employment under the Servicemen's Readjustment Act of 1944 (the G.I. Bill) overwhelmed the higher education marketplace. New institutional types flourished, such as the 2-year community college. New technologies led to course offerings from specialized departments ranging from computer sciences to the vast array of allied health fields. These new departments have often been among the first to embrace a PBL curriculum. Nothing exemplifies the utility of education better than a course of study wholly constructed around real world scenarios and student-driven inquiry into knowledge they perceive as necessary to become competent practitioners in their disciplines.

Diversity of Learners

Higher education in the United States has gradually moved from an elite enterprise to a universal activity that educates over 50% of the eligible cohort. The shift from an agrarian to an industrial, and lastly to a technological and service-oriented society, caused an increased need for advanced education. Waves of immigrants, a baby boom, and trends toward larger families gave more urgency to the problem. Beginning with the Morrill Acts of 1862 and 1890, through the G.I. Bill, and up to the present-day affirmative action debates, higher education has expanded and changed to accommodate greater total numbers and a higher percentage of nontraditional students. The current trend toward access and opportunity continues through distance-learning technologies and federal financial aid opportunities.

A problem-based curriculum is individualized and student-driven. It is enhanced by the diversity of input into the educational black box. Male and female students of various cultures, religions, ages, and life experiences devise differing learning issues in a problem-based learning experience. As the diverse learning issues are resolved, the learning experience is enhanced for all, much more so than a traditional lecture prepared by a single traditionally trained instructor. Granted, the professoriate has experienced diversification as well, so the traditional lecture is not as culturally static and uniform as it once was. A new generation of academics (defined by Finkelstein, Seal and Shuster as those having less than 7 years' experience) brings forth a greater percentage of women, foreign-born, and minority scholars. The change is especially prominent in the community college system (Finkelstein, Seal, & Shuster, 1998). It is true that diversity in the professoriate has lagged behind the rapid changes in the student demographics, especially in research institutions and in certain disciplines such as science and engineering. PBL is one way to help a professoriate still primarily staffed from the dominant culture create a rich learning experience for all students.

The Debate Over Content

Stark and Lattuca (1997) framed the content debate as one of prescription versus choice. Calls for a core curriculum, mandatory courses, and distribution requirements have tried to strike an uneasy balance with student protests for relevance and academic freedom, innovative educators advocating elective courses of study, and demands for pluralism and representation in any required canon of literature. Present-day higher education in the U.S. is more elective and more conforming to the spirit of freedom of inquiry than at any other time in its history. With only minimal guidelines concerning degree requirements and a core of courses common to all, most students have an unprecedented choice from a broad range of institutions, majors, and individual courses.

Problem-based learning embodies the spirit of the content debate. In the 1970s, educators were concerned with the currency and relevancy of the materials presented in lectures. Students wanted to discover their own learning issues and resolve them in ways meaningful to them. PBL has been a means to bring the educator and student together as co-investigators who together strive to create structure and meaning from various data points.

The Discussion of Instructional Process

The tension between passive and active learning has been the crux of the instructional process discussion. Stark and Lattuca (1997) refrained from using the word debate in this particular instance, because they claimed there is little evidence that these innovations were opposed with much vigor. Over the centuries, there has been a decided move away from recitation, memorization, and the perceived need to furnish the learning mind with classic thought. The modern day university makes use of laboratories, discussion, seminars, independent study, and experiential learning.

It is in this context of passive/active learning that the proponents of PBL have most frequently operated. PBL in its most classic form is purely active learning with only facilitation and guidance from faculty. Opponents claim that the overwhelming student-centeredness of problem-based learning is an abdication of faculty responsibility to set the educational agenda. Many faculty have voiced discomfort in their new role of facilitator, even termed a "co-learner" in some instances.

One significant change in educational process over the years is the consideration of how adults differ from children in their approach to learning. The processes involved in problem-based learning are best appreciated in the context of the adult learner. The foundations for PBL draw heavily from the work of Knowles (1970) and Vygotsky (1980) regarding the educational psychology of the adult learner. The term "andragogy" has been defined as the art and science of helping adults learn. This should be contrasted with the pedagogical model, which was developed from educators' experiences with very young children. The andragogical model of learning and teaching carries with it some assumptions regarding learners: (a) the need for self-directedness, (b) the intrinsic worth of learning outside the classroom, and (c) the learner's reservoir of experience as a valuable resource. Although students may not have experience in the area presently under study, the knowledge to be imparted can be expected to lie just outside of a student's zone of proximal development. As Vygotsky (1980) described, this is most apparent in the overlapping zones of a learning group, in which a member of a working group is ready to understand more than is a single learner.

Knowles (1970) also believed that the andragogical model leads to a perspective change in learning, from one of postponed application of knowledge to one of immediacy of application. In PBL, didactic exercises, which once seemed remote and removed from the real world, become wholly relevant, and will be applied to practice in the not-too-distant future. The entire PBL educational experience is, for the most part, very goal-directed and is perceived as arising from a need to know. Gone is the view on information stockpiling so common in traditional educational programs. The curriculum is motivating because the knowledge it imparts is considered necessary not just for examinations, but for careers.

PBL can best be understood in terms of a preclinical apprenticeship, putting knowledge to practical use months or years before a student is ready to care for actual patients. The faculty member models the processes they hope to produce in their future colleagues. The faculty facilitator eases the transition from previous information to new learning, while offering support and reassurance in a secure classroom situation where errors in judgment and reasoning can still be tolerated. It is then necessary for the faculty member to fade to the role of advising or mentoring, for one of the greatest hazards in this method is the faculty member getting in the way of learning. They must trust that the carefully designed series of problems will guide learning groups to the essential points in the curriculum, without having to resort to a transmission mode of teaching. Appreciation for the method, the excitement of self-discovery, and developing the habit of lifelong learning behavior is "an end in itself, and not just . . . protection against impending examinations." (Walton and Matthews, 1989, p. 551).

One could also expect that the transfer of learning will be increased. Norman and Schmidt (2000) voiced some concerns in this area. They wondered if there is such a thing as a learnable problem-solving skill, and they cited studies showing content specificity in problem solving, or poor correlation of performances across problems. It was for this reason that they concluded that there cannot be broad transfer of knowledge, for the minor surface discrepancies in a future problem will hamper the recognition of the analogy. They conceded, however, that learning in a problem-solving group would result in enhanced activation of prior knowledge, elaboration of knowledge, and future matching of context. Although this active process will be less efficient at the start, after solving a well-devised series of problems, this group will have the same content as learners in a lecture-based curriculum. Studies show that the active learners will have enhanced recall as well (Norman & Schmidt, 2000).

We also must avoid the desire to find a panacea for the difficulties in education. Just as there are some who will benefit from the PBL philosophy, there are others who can be expected to experience profound culture shock in the redefined student role. Some students will feel overwhelmed in the new role, and may hide inside the group process as a passive observer. It is for the sake of these learners that the traditional tools of education should be maintained, even improved upon. The traditional lecture can be saved, turning it into an active learning experience. In *Teaching Tips*, Wilbert McKeachie described two alternate lecture models (McKeachie, 1999). The feedback lecture involves two mini-lectures separated by a small group study session that is centered around study guide questions. The guided lecture has students listen without taking notes first, then they write for 5 minutes about what they remember, finally they spend the remainder of the class discussing in small groups what they wrote about the lecture. Improved lecture techniques may be a useful and efficient adjunct to problem solving groups.

A final concern is that there is a certain core of knowledge that must be taught if the National Certifying Exam is to be passed. Despite well-intentioned efforts to maximize student self-directedness, faculty must assist students in a careful needs assessment to insure that the core knowledge is being acquired. As discussed above, a lecture series parallel to the problem-solving experience may be the best route to this end.

Problem-based learning is one way of enhancing retention of information and transfer of learning in the medical professions, such as the sampling of PA students presented here. Its principles are supported by the literature on the andragogical model of learning and teaching, provided that there is some leeway for the judicial application of pedagogical practice when appropriate. PBL can help to meet the student's need for specific knowledge, aid in cognitive development, and hasten socialization into the role of health practitioner.

Evaluation, Accountability, and Quality Control

Stark and Lattuca (1997) described a growing demand for assessment and accreditation. The number of stakeholders in the educational enterprise is increasing, including federal and state governments, private benefactors, and corporations. Students themselves are increasingly seen as consumers themselves, and demand accountability. Every one of the innovations previously mentioned presented a need for meaningful outcome assessment at its inception. If we have no reliable means to judge the effectiveness of one teaching modality over another, curriculum design is deconstructed to become merely a matter of personal preference. Unfortunately, the evidence is mounting that curricular innovations usually result in no significant difference in outcome.

In *The Teaching-Learning Paradox: A Comparative Analysis of College Teaching Methods,* Dubin and Taveggia (1968) discussed methods for choosing preferred instructional technologies. They alleged that it is largely non-scientific criteria such as "temperament of the professor" and "a belief-system that alleges superiority for the preferred teaching method" which guides the choice (Dubin & Taveggia, 1968, p. 1). They stated that up to that time, there had been no clear evidence of superiority of one teaching method over another, and they set out to try to provide evidence upon which future curricular decisions could be made.

Dubin and Taveggia (1968) alluded to the black box of educational interventions. They listed instructor inputs as subject knowledge, judgment, and analytical skills.

Student inputs to the black box include voluntarism, knowledge base, and motivation. Inputs interact with one another in the black box of any educational intervention, and output variables are operationalized and measured. Dubin and Taveggia found that the outcome measure that was most commonly utilized was the final examination administered some time after completion of the educational intervention.

In their landmark meta-analysis, Dubin and Taveggia (1968) analyzed the data from 91 studies from 1924 to 1965 comparing different instructional methods, including lecture, discussion, and independent study. They found no measurable difference among methods of college instruction as measured by student performance on final examinations. Their implications for further research included exploration of the commonalities in various teaching interventions and the development of teaching-learning models that will reveal more fully the activities in the black box.

The black box analogy remains meaningful today, and still not enough is known about the activities within it. As recently as 2000, Hak and Maguire discussed the black box in the context of problem-based learning. They reaffirmed that not enough research has been done into the actual activities and learning processes that moderate PBL outcomes. They advocated more qualitative research using videotaping, participant observation, and questionnaires to provide a naturalistic view of PBL activities as they unfold (Hak & Maguire, 2000).

Thomas Russell (2001) provided further evidence of the equivocal nature of instructional methods. In *The No Significant Difference Phenomenon*, he produced a bibliography of 355 studies published between 1924 and 1998. These studies compared distance learning modalities to face-to-face classroom experiences. Distance learning methods from correspondence courses to televised curricula to Internet-assisted technologies were included in the studies. Repeatedly, no one medium emerged as consistently better or worse (Russell, 2001). Russell's project is ongoing, with studies since the publication of his book listed at the website http://teleeducation.nb.ca/nosignificantdifference (Russell 2004).

At first glance, Russell's bibliography seems discouraging. With mounting evidence that new modalities provide no significant improvement in outcomes, it may appear as though nothing we do as educators makes a difference. Yet Russell's conclusions are optimistic. The good news, according to Russell, is that new instructional technologies do not interfere or denigrate teaching and learning, for no positive or negative significant differences have been observed. We can feel free to adopt less expensive and simpler technologies and be assured that outcomes will very likely resemble costly or complex established methods of instruction (Russell, 2001).

As noted above, novel educational technologies have appeared in American higher education throughout its 350-plus year history. Each enjoyed a period of time in vogue, as problem-based learning currently enjoys. One can imagine some ancestral researcher in the Thomas Russell mode asserting that each new way of teaching does not improve outcomes. Many of these innovations were developed and promulgated because they fit well into someone's temperament or belief-system, the driving criteria for choice of instructional method according to Dubin and Taveggia (1968). Yet these innovations took hold and are now so well established as to be second nature.

These five longstanding debates within the higher education community may never have definitive resolution. As innovations appear to settle some issues, other dormant discussions find renewed vigor. Higher education is a vital institution finding itself very often in the vanguard of revolutionary change. Forming high quality health care practitioners is paramount to the continued health and well-being of society. Therefore, when Stark and Lattuca's (1997) five threads of discourse converge in a discussion of how we educate future health care professionals, society should take note. I believe the nature of problem-based learning and the extent to which it is used in medical education is such a point of conversion.

Colliver's Literature Review in Greater Detail

The current investigation clearly takes its lead from Jerry Colliver's (2000a) literature review of PBL in medical schools. This review was mentioned in chapter 1; a more detailed discussion of his findings is presented here.

He began his 2000a article by discussing three reviews of PBL published in 1993. He then performed a literature review for studies comparing PBL to traditional medical school curricula. He narrowed his search to nine prominent medical journals: *Academic Medicine, Advances in Health Sciences Education, Evaluation and the Health Professions, Medical Education, Teaching and Learning in Medicine, Annals of Internal Medicine, Archives of Internal Medicine, Canadian Medical Association Journal,* and the *Journal of General Internal Medicine.*

Colliver (2000a) chose these journals based on past experience with the PBL literature. Peer reviewers, also familiar with PBL, did not report any significant omissions of studies in a draft of his paper. He was then confident that a careful search of these nine journals had revealed "most, if not all, of the major relevant articles."

(Colliver, 2000a, para. 5). The findings of Colliver's research are summarized in Figure 1.

Throughout Colliver's (2000a) literature review, the most common objective measures of medical student achievement are step I and II of the US Medical Licensing Examination (USMLE). Step I evaluates a student's knowledge of important concepts of basic sciences. It includes test items in the following content areas: anatomy, behavioral sciences, biochemistry, microbiology, pathology, pharmacology, physiology, and certain interdisciplinary topics such as nutrition, genetics, and aging. This exam is commonly given to medical students after completion of their preclinical education.

Step II of the USMLE assesses a student's ability to apply medical knowledge and scientific concepts, and includes emphasis on health promotion and disease prevention. It includes test items in the following content areas: internal medicine, obstetrics and gynecology, pediatrics, preventive medicine, psychiatry, and surgery. It is typically given to students after completion of core clinical educational experiences.

In a randomized study by Mennin, Friedman, Skipper, Kalishman and Snyder (1993) at the New Mexico School of Medicine, the dependent variable was the score on the medical licensing exam. PBL students scored significantly lower than traditional students in NBME I ($d = -.85$, $p < .01$). They scored lower on NBME II ($d = -.16$) and NBME III ($d = -.33$) but these differences were not statistically significant (Mennin et al., 1993).

Figure 1. Summary of research into PBL in medical education 1993-1998.

Researcher and Year	Study Population	Outcome measure	Results		*p* value
Mennin 1993	UNM		Lecture based	Problem-based	
		USMLE I	504 (n = 508)	456 (n = 167)	.0001
		USMLE II	460 (n = 447)	469 (n = 144)	.29
		USMLE III	491 (n = 313)	521 (n = 103)	.001
Moore 1994	Harvard		Lecture-based	Problem-based	
		USMLE I	0.07	0.06	.96
		Behavioral Science subtest	-0.09	0.37	.01
Richards 1996	Bowman Gray	Clinical ratings:	Lecture-based N = 401	Problem-based N = 91	
		Factual knowledge	2.90	3.11	.001
		History/ Physical exam	3.05	3.22	.002
		Differential diagnosis	2.86	3.04	.0005
		Organization/ expression of information	3.33	3.49	.004
Schmidt 1996	3 Dutch schools	Performance on 30 case studies	Curricular type F = 14.40 among 3 schools		.0001
			Curricular type x time F = 3.795 among 3 schools		.001

Figure 1 (continued)

Researcher and Year	Study Population	Outcome measure	Results		*p* value
Hmelo 1996	Population A = one Midwestern US school	Problem solving	Lecture-based	Problem-based	
		Accuracy	School A 2.45 (*n* = 16)	4.29 (*n* = 19)	
			School B 2.80 (*n* = 20)	3.48 (*n* = 19)	
	Population B = one Southern US school	Coherence	School A 0.98 (*n* = 16)	2.50 (*n* = 19)	
			School B 1.17 (*n* = 20)	1.38 (*n* = 19)	
		Comprehensive-ness	School A 0.86 (*n* = 16)	1.93 (*n* = 19)	
			School B 0.88 (*n* = 20)	1.11 (*n* = 19)	
		Use of scientific concepts	School A 1.00 (*n* = 16)	4.39 (*n* = 19)	
			School B 2.50 (*n* = 20)	2.42 (*n* = 19)	
Distlehorst 1998	SIU		Lecture-based	Problem-based	
		USMLE I	198 (*n* = 154)	199 (*n* = 47)	.6258
		USMLE II	199	206	.0518
		Subjective clin eval	3.87	4.11	.0028
		Objective clin eval	70.88	72.4	.0596
Kaufman 1998	Dalhousie U (Canada) classes of 1995-1997	MCC Exam part I	Lecture-based *N* (1995) = 81	Problem-based *N* (1996) = 84, *N* (1997) = 78	
		Overall	499.4	508.6/ 513.9	.76
		PMCH subtest	494.1	499.5/ 547.9	.001
		Psychiatry subtest	482.4	524.8/ 516.5	.001

Figure 1 (continued)

Researcher	Study Population	Outcome measure	Results		*p* value
Ripkey 1998	118 medical schools	USMLE I	Discipline-based, *n* = 38974 210.1 Discipline based yr 1, systems based yr 2, *n* = 5754 210.8	Systems-based, *n* = 3796 209.1 Other including pure PBL, n = 6366 210.1	Not signifi-cant

Note. Adapted from Colliver, J. A. (2000b). Effectiveness of problem-based learning curricula: Research and theory. *Academic Medicine*, 75(3), 259-266.

Moore, Black, Style, and Mitchell (1994) studied the New Pathway curriculum at Harvard Medical School. There was no significant difference between groups in NBME I (*d* = -.01, *p* = .96). In the subtests, significant differences were only seen in behavioral sciences (*d* = .46, *p* = .01). This can be attributed to significantly more exposure to behavioral sciences in the New Pathway rather than the instructional methods employed (Moore et al., 1994).

Schmidt, Machiels-Bongaerts, Hermans, ten Cate, Venekamp and Boshuizen (1994) studied Dutch medical students who were given tests in the form of written clinical vignettes. Both years of medical school training and curriculum type produced significant differences (*p* = .0001). However, curriculum type accounted for 1% of the variance, compared to 74% of the variance resulting from years of medical school. Richards et al. studied a two-track system at Bowman Gray School of Medicine. There was no difference in NBME I scores (*d* = .07, *p* = .80) and small but significant differences were seen in ratings by clinical supervisors (*d* = .39 to *d* = .50) (Schmidt et al., 1994).

Hmelo (1998) studied students of Rush Medical College. These students were given scores at several points in the five step case-based test, and these scores were summated into an aggregate score. PBL students scored higher in accuracy of diagnosis, length of reasoning chains, accounting for clinical findings, and use of scientific concepts. It was noted, however, that 89% of PBL students and 89% of traditional students made the correct diagnosis by the end of the case (Hmelo, 1998).

Distlehorst and Robbs (1998) conducted research in the SIU School of Medicine. No significant differences were seen in NBME I (*d* = .18, *p* = .2707) or in post-clerkship standardized patient examinations (*d* = .30, *p* = .0703). However, in NBME II there was significant improvement (*d* = .39, *p* = .0197). There was also a significantly higher rating by preceptors of the PBL group (*d* = .50, *p* = .0028) (Distlehorst & Robbs, 1998).

Kaufman and Mann (1998) studied performance on the Canadian medical licensing exam by students of the Dalhousie University School of Medicine. Total score, score on multiple choice test items, and problem solving score were studied, as well as pass rates on the exam. A traditional graduating class (1995) was compared to two classes having PBL curricula (the classes of 1996 and 1997). There were no significant differences between 1995 and 1996 or between 1995 and 1997 (Kaufman & Mann, 1998).

The final study cited by Colliver (2000a), conducted by Ripkey, Swanson and Case (1998) for the National Board of Medical Examiners, examined test results across four types of curricula: discipline-based, organ system-based, a combination of discipline-based first year/organ system based second year, and other which included PBL. There were no significant differences in mean scores, and the differences further decreased when controlled for difference in medical college admissions test scores (Ripkey, Swanson & Case, 1998).

Colliver (2000a) has focused a critical eye on problem-based learning within the curricula of medical schools. A similar critical view of PBL in other disciplines of higher education cannot be found in the literature. Will similar disappointing and equivocal results be found in replicating his critical analysis in other disciplines? This study will build on the literature addressing PBL in medical schools and attempt to broaden the debate to the realm of allied health professions education, namely, physician assistant education programs.

Chapter III

Methodology

Theoretical Framework of the Study

There were two overarching objectives of this study, mirroring the research questions presented in chapter 1. The first objective was to describe the level of implementation of problem-based learning in physician assistant programs in the United States. The second objective was to determine the effect of a specific curricular innovation (problem-based learning) on objective outcome measures such as certification exam scores.

This research design was informed by the writings of Jerry Colliver (Colliver, 2000b). His discussion of PBL was limited to medical schools; however, it was hypothesized that an analogous situation may be studied in the universe of physician assistant education. His use of the United States Medical Licensing Examination (USMLE) as a common outcome variable was instrumental in the operationalizing of variables within this study design. The Physician Assistant National Certifying Examination (PANCE) emphasizes clinical application of knowledge rather than basic science information, and thus is the outcome variable which is most analogous to the USMLE Step 2 examination within the physician assistant universe.

The methodology employed in this survey was also inspired by a 1999 study by Lisa McDowell et al. (McDowell, Clemens, & Frosch, 1999). In this study, the researchers sought to show a causative connection between independent variables such as degree granted, curriculum length and length of time since initial program accreditation, and dependent variables derived from program scores on the Physician Assistant National Certifying Examination (PANCE). This study concluded that graduate level programs and programs with a longer time since initial accreditation had significantly higher scores on the PANCE. Similar access to PANCE scores was sought and obtained for this study.

The National Commission on Certification of Physician Assistants (NCCPA) administers the Physician Assistant National Certifying Examination. Since its inception, the NCCPA has maintained data on the certification of physician assistants. Research personnel at the NCCPA are available to assist and advise individuals researching the profession.

The current study was also informed by the 11-point continuum devised by Harden and Davis that was detailed in chapter 1 (Harden & Davis, 1999). This was the most detailed and specific attempt to describe activities within the black box of PBL activities; it has been adapted here for use in the census instrument.

Design of the Study

The design of the study was initially developed in a sequence of classes offered by the Department of Education Leadership, Management and Policy, College of Education and Human Services of Seton Hall University. In courses entitled Directed Research, Dissertation Seminar in Higher Education I and Dissertation Seminar in Higher Education II, problem finding and formulation were explored with faculty and fellow doctoral students. As a result of the reiterative process in this coursework and subsequent development, the following research questions and hypothesis were formulated:

The research question under investigation was: Problem-based learning (PBL) has been increasingly used in Physician Assistant educational programs. What is the current level of utilization of PBL in the universe of Physician Assistant education? This question will be termed Research Question One in the following pages.

A subsidiary question under investigation was: How has this curricular change affected academic achievement as measured by performance on the Physician Assistant National Certifying Examination (PANCE)? This question will be termed Research Question Two in the following pages.

The null hypothesis under investigation stated that there is no significant difference in educational achievement among physician assistant programs based upon the level of problem-based learning activities in the curriculum. Rejection of this null hypothesis would result in acceptance of an alternative hypothesis asserting that physician assistant programs with higher levels of PBL activity will have higher academic achievement than physician assistant programs with lower levels of PBL activity.

Census of the Population

The population under investigation was defined as all fully accredited physician assistant education programs in the United States. The number of accredited PA programs at the time of the study was 133 (Accreditation Review Committee on Education for Physician Assistants, 2004) . Earl Babbie in *Survey Research Methods* listed the two most common reasons for sampling as time and cost (Babbie, 1990). Since neither time nor cost is prohibitive with a total population of 133, it was decided to attempt a census of the entire population rather than a survey of a representative sample. Several programs listed as accredited by the ARC-PA were known by the author to be very new. Their status is more accurately described as provisionally accredited, and a corollary to this fact was that the program had not as yet graduated a class. Since certification exam scores would not be available, these programs were not sent a survey. This lowered the total number of mailed surveys to 130.

Independent Variables

Investigation into Research Question One (What is the current level of utilization of PBL in the universe of Physician Assistant education?) required a careful operationalizing of the rather subjective characteristic of problem-based learning activities within the classroom. The major independent variable of interest in Question One was the level of problem-based learning curricular activities present in the program's didactic (preclinical) phase. PBL activities in the clinical phase are by nature problem-based; that is, they are composed largely of supervised patient care activities. For this reason, survey respondents were asked to limit their responses to the didactic phase of their curriculum.

Research Question Two (How has this curricular change affected academic achievement as measured by performance on the Physician Assistant National Certifying Examination?) used the same data on PBL utilization analyzed descriptively in Question One. This data was then be analyzed as a possible independent variable in a cause-and-effect relationship between PBL utilization and academic achievement. The major independent variable of interest in Question Two, as in Question One, was the level of problem-based learning curricular activities present in the program's didactic (preclinical) phase.

Problem-based learning in physician assistant programs nationwide was assessed using a survey instrument incorporating a matrix inventory census (Appendix A). This was sent to program directors of fully accredited PA programs. The census was designed to elicit descriptive responses of what constitutes PBL for their program. The 11 independent variables, types of PBL activity, assessed in this census were adapted from Harden and Davis's 11-point typology (Harden & Davis, 1999). The 11 steps move from a focus on concepts and rules to one of examples and illustrations. Traditional lectures emphasizing rules and theory appear at one end of their continuum, while curricula delivered entirely through student-driven experiential learning appear at the other end. Graphical depictions of the learning activity with accompanying text appear in the vertical axis of the matrix shown in Figure 1. Respondents were asked to indicate the dominant educational activity for each curricular area in the matrix census. Graphic diagrams adapted from Harden and Davis were included in the census instrument and will help respondents to assess their use of rules (Rul) and examples (Eg) in the delivery of curricula to students.

The content of the curricular component domain was operationalized using the Accreditation Standards for Physician Assistant Education published by the Accreditation Review Commission on Education for the Physician Assistant (2004). This document contained several curricular requirements that every PA Program must offer in order to maintain accreditation. These content areas are a least common denominator for all PA

Programs, and limiting discussion to these required content areas will make for fairer comparisons of disparate programs. These appear in the horizontal axis of the matrix.

In addition to PBL activities, several other independent variables were investigated as possible confounding variables in their effect on academic achievement. Several studies have attempted to identify factors influencing educational outcomes in PA education. Skaff, Rapp, and Fahringer (1998) surveyed graduate PAs and their employers to evaluate three outcome variables after 2 years of employment: knowledge base, communication skills, and clinical competency. The survey results were then compared to PA Program record reviews to evaluate associations with early variables such as GPA at time of application, admission test scores, and interview ratings. They concluded that the best predictor of graduate success is performance during admissions interviews. They minimized the use of GPA and test scores as admissions criteria and cited supportive studies that also favor non-traditional measures of applicants such as interpersonal skills and communication. Skaff et al. then recommended specific changes in interviewing techniques based upon their survey research.

Mc Dowell et al. (1999) investigated the influence of degree granted, length of curriculum and duration of accreditation on PANCE scores. It was found that a terminal masters degree and a longer time since initial accreditation both had a statistically significant positive correlation with PANCE performance.

Oakes, MacLaren, Gorie and Finstuen (1999) examined the following independent variables and their effect on PANCE scores: age, gender, education level in years, class standing, previous direct patient care experience, and performance within the didactic and clinical phases of the PA Program. Since the study was done in the

Interservice Physician Assistant Program, several factors unique to military service (pay grade, branch of service, military area of occupation prior to PA study) were also considered. Significantly positive effects on PANCE scores were related to strong performance in the didactic phase and clinical phase of the PA program, younger age, lack of prior patient care experience, and fewer total years of higher education.

There is no entrance examination that is required universally by all programs; therefore, tests such as the Allied Health Professions Admission Test and the Graduate Record Examination were not used as independent variables.

Based on this body of literature, six independent variables were added for consideration in this study, as possible confounding variables in an assessment of the effect of PBL in the curriculum. These possible confounding variables included terminal credential, years of operation of program, geographic location age of didactic-phase student, gender of didactic-phase student body, and racial makeup of didactic-phase student body. Geographic location as defined in this study was derived from a program's membership in a regional consortium as defined by the Association of Physician Assistant Programs (Figure 2). These demographic factors were assessed in a series of supplemental questions that was placed behind the census matrix as page three of a three-page mailed survey instrument. They were coded for data analysis based upon the scheme in Figure 3.

Figure 2. Consortia of the Association of PA Programs

West	Midwest	Heartland	Southeast	Northeast	East
AZ	IL	KS	AL	CT	DE
AK	IN	LA	AR	MA	DC
CO	IA	NE	FL	NH	MD
CA	MI	OK	GA	NJ	PA
HI	MN	TX	KY	NY	
ID	MO		MS	ME	
MT	ND		NC	RI	
NV	OH		SC	VT	
NM	SD		TN		
OR	WI		VA		
UT			WV		
WA					
WY					

Figure 3. Coding of demographic independent variables

Variable	0	1	2	3	4	5
Terminal credential	Less than baccalaur level	Baccalaur credential	Graduate level credential			
Years of operation	less than three years	4 to 6 years	7 – 9 years	10 – 12 years	Over 12 years	
Geograph. region	Northeast	Eastern	Southeast	Midwest	Heartland	Western
Age of didactic phase students	Mean age 21 – 23	Mean age 24 – 26	Mean age 27 – 29	Mean age 30 and above		
Gender of didactic phase students	0 – 20 % male	21 – 40 % male	41 – 60 % male	61– 80 % male		
Race of didactic phase students	0 – 10% nonwhite	11 – 20% nonwhite	21 – 30% nonwhite	31 – 40% nonwhite	41 – 100% nonwhite	

Dependent Variables

In studies of medical schools in the United States, a common measure of academic achievement is the United States Medical Licensing Examination (USMLE). This was the objective measure used most often in the studies of Colliver's 2000 literature review. The exam is administered in three steps (National Board of Medical Examiners, 2004.) Step 1 emphasizes the basic sciences according to general principles and specific organ systems. Step 2 is designed to demonstrate clinical applications, both knowledge and skills. Step 3 is a capstone examination in the three-stage process designed to assess an individual's preparation for the unsupervised practice of medicine. Steps 1, 2, and 3 have all been used as outcome variables to measure medical student achievement.

Since physician assistants are trained to be dependent practitioners, working in close collaboration with a supervising physician, there is no examination analogous to USMLE Step 3 in PA education. With a contracted 2-year duration, and a marked emphasis on practical applied knowledge, physician assistant education offers very little resembling USMLE Step 2 on a national level. Individual programs may mark a clear transition from basic sciences to applied clinical sciences with some sort of exam, but this is not common.

What credential is to be used to make comparisons to outcomes in medical schools? Physician assistant credentialing varies greatly from state to state. One prerequisite credential is required by all 50 states: certification by the National Commission on Certification of Physician Assistants. This is achieved by passing a single 360-item multiple-choice test administered via computer shortly after graduation. This test is the Physician Assistant National Certification Examination (PANCE). This is the variable in PA education which is most analogous to the USMLE, possessing a design similar to the USMLE Step 2 exam.

With the cooperation of researchers at the NCCPA, two outcomes variables were obtained for each respondent program: average scores for first-time test takers in 2002, and program pass rates for first-time test takers in 2002. The year 2002 was the most recent year for which the NCCPA had complete data, so data from these testing windows was chosen. Furthermore, the data was limited to first-time test takers because it was believed that the program curriculum would be the most proximate cause for achievement on the PANCE exam for this subset of test takers. The data for all test takers would have included examinees taking the PANCE exam for the second or third time. This could have conceivably introduced the bias of post-program experiences such as work, exam review courses, and increased time for self-study. For these reasons, the data was limited to first-time test takers in 2002.

Further Development of the Survey Instrument

The census matrix instrument was further developed in a Survey Research course offered by the Department of Education Leadership, Management and Policy, College of Education and Human Services of Seton Hall University. The draft version of the census matrix was completed as part of this coursework.

The research instrument was field tested by the administrators of the Joan and Sanford I. Weill Medical College of Cornell University Physician Assistant Program. Four of this program's administrators (Program Director, Senior Preclinical Coordinator [who is also the primary investigator of this study], the Preclinical Coordinator, and the Senior Assessment Coordinator) were each instructed to complete the survey matrix with regard to the Weill Cornell PA Program's preclinical curriculum. There was much agreement across the four respondents, with a modal response established for each category. It was inferred from this field test that the instrument was understandable and that several individuals familiar with a program's preclinical curriculum could be expected to complete the survey in similar ways. This served as evidence of the instrument's internal validity.

The research instrument, informed consent forms, and recruitment letter were reviewed and approved by the Seton Hall University Institutional Review Board. In addition, the Research and Review Committee of the Association of Physician Assistant Programs (APAP) also approved the research instrument. This added step entitles a researcher to place language in the recruitment letter discussing the approved status of the questionnaire. This is expected to increase the response rate, for busy PA program administrators and faculty are less inclined to discard research materials that bear the approval of the APAP.

Data Collection and Analysis

A Microsoft Excel spreadsheet was created with names, NCCPA identification numbers, mailing addresses, and e-mail addresses for the 130 fully accredited programs nationwide (NCCPA, 2002). An initial mailing was sent to each of the 130 programs. A second mailing to nonresponders followed in 12 weeks. This mailing contained essentially the same enclosures as the first mailing, with a cover letter updated with a new deadline and additional language encouraging the program's participation. A final electronic follow-up terminated the recruitment and initial data collection phase of the research. This was done using the most recent e-mail contact published on the website of the NCCPA.

Data was then sent in the form of an Excel spreadsheet to the research division of the National Commission on Certification of Physician Assistants (NCCPA). The NCCPA research staff contacted program directors once again to insure each program's continuing willingness to participate. Five programs chose to withdraw from the study following this communication from NCCPA. Researchers at the NCCPA added to the spreadsheet the mean program scores and pass rates on the 2002 PA National Certifying Examination (PANCE) for the 33 programs remaining in the study. Once this program-specific data had been added, the research assistants at the NCCPA replaced both the program name and identification number with a unique random numerical identifier, to preserve program confidentiality.

The data was then returned and analyzed using the Statistical Package for the Social Sciences 10 (SPSS 10) statistical software program. Research Question One involves descriptive analysis of the levels of PBL utilization. Maximum and minimum values, mean and modal measures of central tendency, and standard deviation will be calculated using the descriptive statistical analysis within the SPSS program. Research Question Two involves a search for correlation among variables. An exploratory principal component analysis was planned for data reduction and to determine which components of the Harden and Davis (1999) typology best explain the variance in PANCE scores. However, consultation with a statistician convinced the author that the study group was too small for a meaningful exploratory principal component analysis. The ordinal data collected was then analyzed using Spearman's rho correlation.

A new variable, total PBL score, was calculated using the sum of PBL scores across all subjects for each program. Although this ordinal data lacked the precise comparative rankings that interval-ratio data would have provided, it still served to sort programs in rank order based on the extent to which each program utilized PBL. The lowest scoring programs were coded 1, the midrange programs were coded 2, and the highest scoring programs were coded 3. Using this coding, the programs were stratified into low-, medium-, and high-PBL groups. Analysis of variance (ANOVA) with Levene's test for homogeneity of variances and Tukey's post-hoc analysis determined the nature of any observed differences in PANCE scores across these groups.

Lastly, ANOVA was performed on disaggregated data to determine if teaching any single subject with higher levels of problem-based learning resulted in significantly improved outcomes in PANCE scores. This was accomplished with ANOVA, Levene's test for homogeneity of variances and Tukey's post-hoc analysis.

Limitations

There has been an explosion in growth of PA programs nationwide. In limiting the sample population to fully accredited programs, there will be no data from new programs seeking or presently holding provisional accreditation. As the PA educational universe expands, replication of the study can address this limitation by enlarging to include all recently accredited programs.

The instructions accompanying the survey instrument are detailed, with some rather subtle differences between independent variables. Although every effort has been made to create an instrument that is both informative and easy to use, the complexity of the requested responses may negatively reflect both the response rate and the reliability of responses.

Using the methods outlined above, the effect of problem-based learning in physician assistant education will be critically assessed, just as the PBL curricula of medical schools has been recently evaluated. It is hoped that a productive dialogue may ensue among PA educators, and higher student achievement and enhanced quality of education may be the end result.

Chapter IV

Findings

Individuals completing the survey on behalf of a PA program were asked to choose the predominant mode of instruction for each of the curricular components listed. They were to choose among 11 modes of instruction, designed to reflect the 11 gradations of problem-based learning described in the research of Harden and Davis (Harden & Davis, 1999). Twenty-five curricular components were included, derived from 25 areas of study required in published standards for accreditation (Accreditation Review Committee on Education for Physician Assistants, 2001). Demographic information was also obtained to assess the comparability of participating programs to the general character of programs nationwide, as published in the most recent survey sponsored by the Association of PA Programs (Simon, 2003).

In this chapter, the findings of this survey are reported. The demographic data of participating programs are reported. Chi-square testing is performed where possible to compare the findings with expected values extrapolated from the most recent national survey data. The descriptive statistics concerning the utilization of PBL in PA education follow. Chapter 4 concludes with a presentation of the findings regarding problem-based learning activity as a predictor of success on the PA National Certifying Exam (PANCE). The dependent variable of success on the PANCE was operationalized as a program's PANCE pass rate for first-time test takers and a program's PANCE mean score for first-time test takers. Correlation between PBL activity and each of these outcome variables will be investigated using the Spearman's rho value. ANOVA will also be performed to detect differences in outcome variables across groups stratified by level of PBL utilization.

Surveys were sent to the program directors of 130 accredited physician assistant programs nationwide. There was an initial survey return rate of 29% (38 of 130). This included all programs whose representatives responded following an initial mailed survey, a second mailing to nonresponders, or final follow-up through electronic mail. The second phase of data collection involved the release of program pass rates and mean scores by the National Commission on Certification of Physician Assistants (NCCPA). Prior to the second phase, the NCCPA sought confirmation of each program's continued willingness to participate in the study. A PDF copy of the original informed consent was attached to this electronic mail enquiry by the NCCPA. Nevertheless, an additional five programs ended their participation in the study at that time. This resulted in a final response rate of 33 of 130 programs releasing their certification exam scores for analysis, or a 25% final response rate.

General Characteristics Data for Study Programs

Demographic data was collected to determine if the group of programs responding to the survey was significantly different from the population. Programs were asked to supply their terminal credential offered, length of time since initial accreditation, geographic region, and average age, gender, and racial makeup of didactic-phase students. A chi-square test was performed on the demographic data from the survey. Wherever possible, analogous expected values were determined from the most recent annual report on physician assistant educational programs in the United States and used in the chi-square analysis (Simon, 2003).

The terminal credential for most of the respondents (24 of 33 programs or 72.72%) was self-reported as graduate level. Eight programs (24.24%) were described as baccalaureate level, and one program (0.03%) self-reported a terminal credential as less than baccalaureate level, which includes programs offering an associates degree or certificate of completion.

The chi-square test of the terminal credential granted revealed no significant differences between observed and expected frequencies (Table 1). This is an indication that the relative percentages of non-degree, baccalaureate, and graduate programs in the study population are representative of national trends.

With regard to length of time since initial accreditation, longevity proved to be the rule. Eighteen programs (54.54%) were in operation for 12 years or more since initial accreditation. One (0.03%) was in operation 10 to 12 years. Five programs (15.15%) were in operation from 7 to 9 years. Nine programs (27.27%) were in operation from 4 to 6 years. None of the respondents claimed to be in existence for 3 or fewer years. The chi-square test of length of time since initial accreditation revealed no significant differences between observed and expected frequencies (Table 2). This is further evidence that the study population is representative of the nation at large.

Table 1

Distribution of Programs by Terminal Credential Granted

Credential	Observed *N*	Expected *N*	Residual
Certificate or Associates Degree	1	4	-3
Baccalaureate level	8	11	-3
Graduate level	24	18	6
Total	33		

Test Statistics

Chi-Square [a]	5.068
df	2
Asymp. Sig.	0.079

Note. [a] 1 cell (33.3%) has expected frequency less than 5. The minimum expected cell frequency is 4.0.

Table 2

Distribution of Programs by Number of Years Since Initial Accreditation

No. of years	Observed *N*	Expected *N*	Residual
4 – 6 years	9	9.3	-0.3
7 – 9 years	5	9.3	-4.3
10 – 12 years	1	2.1	-1.1
Over 12 years	18	12.4	5.6
Total	33		

Test Statistics

Chi-Square [a]	5.088
df	3
Asymp. Sig.	0.165

Note. [a] 1 cell (25.0%) has expected frequency less than 5. The minimum expected cell frequency is 2.1.

Geographic region was operationalized as a variable according to a PA program's membership in one of several regional consortia within a national organization for PA educators (the Association of Physician Assistant Programs). The greatest response rate was from the programs of the Northeast Consortium. Ten programs (30.30%) participated from the Northeast. The Eastern Consortium and Southeastern Consortium each contributed five participant programs to the study (15.15%). Eight programs from the Midwest (24.24%), two from the Heartland Consortium (0.06%), and three (0.09%) from the Western Consortium rounded out the remainder of the geographical distribution. The chi-square test revealed no significant differences between observed and expected frequencies of regional consortium membership (Table 3). No region was significantly over- or underrepresented in the study, providing further evidence for its external validity.

With regard to average age of didactic-phase students, 19 programs in the study (57.57%) described a mean age of between 21 and 23 years. The remaining 14 programs (42.42%) described a mean student age between 24 and 26 years. No program completing the survey described a mean age of 27 – 29 (coded as 2) or 30 and above (coded as 3). The chi-square test revealed that the observed student ages were significantly lower than expected values based on national statistics (Table 4). This indicated an overrepresentation in this study population of programs with younger students in their didactic-phase classes.

Table 3

Distribution of Programs by APAP Consortium Membership

Consortium	Observed *N*	Expected *N*	Residual
Northeastern	10	7	3
Eastern	5	5	0
Southeastern	5	6	-1
Midwestern	8	7	1
Heartland	2	3	-1
Western	3	5	-2
Total	33		

Test Statistics

Chi-Square [a]	2.729
df	5
Asymp. Sig.	0.742

Note. [a] 1 cell (16.7%) has expected frequency less than 5. The minimum expected cell frequency is 3.0.

Table 4

Distribution of Programs by Mean Age of Enrolled First-year Students

Age	Observed N	Expected N	Residual
21 – 23 years	19	10	9
24 – 26 years	14	8	6
27 – 29 years	0	5	-5
30 + years	0	10	-10
Total	33		

Test Statistics

Chi-Square [a]	0
df	3
Asymp. Sig.	0

Note. [a] 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

With regard to gender, 17 programs (51.51%) were 0 to 20% male and the remaining 16 programs (48.48%) were 21 to 40% male. No participating program was greater than 40% male. In the APAP nationwide study, enrollment data concerning gender was presented in the aggregate; program-specific means were not reported. As a result, no expected values for a chi-square test could be determined. However, responses were consistent with the aggregate national average for 1st-year enrolled students of 30.4% male and 69.6% female.

Racial demographics also reflected the profession at large. Twenty-six programs (78.78%) stated that their enrolled didactic-phase class was 0 to 10% nonwhite. The remaining six programs (18.18%) fell into the 11 to 20% nonwhite category. No participating program had more than a 20% nonwhite enrollment. As was the case with gender data, enrollment data concerning race was presented in the aggregate in the APAP nationwide study; program-specific means were not reported. As a result, no expected values for a chi-square test could be determined. However, responses were consistent with the aggregate national average for 1st-year enrolled students of 77.4% White and 22.6% nonwhite.

Levels of Problem-based Learning Activity

Problem-based learning activity was ranked from 1 to 11 according to the Harden and Davis (1999) typology. An explanatory table was adapted from Harden and Davis's research and accompanied the survey as an inclusion in each mailing. The survey's cover letter (see Appendix A) directed attention to the enclosed table, and requested that the individual completing the survey take a few minutes to become familiar with its content. The included table is reproduced here as Table 5.

The table provided examples of activities to be included within each PBL level. For example, survey respondents may not consider traditional lectures and standard textbooks to be PBL at all, but the table defines this as PBL Level 1 for the purposes of this study. If a lecture contains significant practical information such as a treatment protocol or guidelines for patient education, the PBL level will increase to Level 2 for the purposes of this study and for closer conformity to the Harden and Davis (1999) literature. Level 10 is the level Harden and Davis termed *problem-based learning*, where a student-centered encounter of a simulated patient with a specific thyroid disease would be generalized to the study of thyroid diseases in general. Level 11 was termed *task-based learning* by Harden and Davis. The real world activities of a professional mentor or preceptor are the trigger to learning in this most extreme type of PBL in the continuum. This is the very definition of the clinical phase of PA education, and every PA program contains some form of clinical clerkships in its curriculum. For this reason, individuals completing the survey were asked to limit their responses to the didactic phase of the program. In this earlier phase of PA education, task-based learning is not a given but may still be seen in limited experiences such as shadowing graduates or examining actual patients in a supervised, controlled setting.

Figure 4. The Harden and Davis continuum of problem-based learning

Level	Terminology	Description	Example
1	Theoretical learning	Information provided about the theory	Traditional lecture, standard textbooks
2	Problem-oriented learning	Practical information provided	Lecture with practical information. Protocols or guidelines
3	Problem-assisted learning	Information provided with the opportunity to apply it to practical examples	Lecture followed by practical or clinical experience. Book with problems or experiences included.
4	Problem-solving learning	Problem- solving learning related to specific examples	Case discussions and some activities in practical classes
5	Problem-focused learning	Information is provided followed by a problem. The principles of the subject are then learned.	Introductory or foundation courses or lecture. Information in study guide
6	Problem-based mixed approach	A combination of problem-based and information-based learning	Students have the option of an information orientated or problem-based approach

Figure 4 (continued)

Level	Terminology	Description	Example
7	Problem-initiated learning	The problem is used as a trigger to begin learning	Patient management problems are used to interest the student in a topic
8	Problem-centered learning	A study of the problem introduces the student to the principles and rules specific to the problem	A text provides a series problems followed by the information necessary to tackle the problem.
9	Problem-based discovery learning	Following the presentation of the problem, students have the opportunity to derive the principles and rules.	Students derive the principles from the literature or from work undertaken
10	Problem-based learning	The development of the principles includes the generalization stage of learning	The investigation of patients with thyrotoxicosis is extended to a more general understanding of thyroid function tests.
11	Task-based learning	Real world situations	Tasks undertaken by a health-care professional are the basis for student 'problems'.

Note. From Harden RM and Davis MH. The continuum of problem-based learning. Medical Teacher, July 1998.

Descriptive Statistics for Research Question One

The survey respondents were instructed to assign one of these PBL levels to each curricular component. The descriptive statistics of PBL levels by curricular component appears in Table 6, with details of individual program responses provided in Table 7. Every program completing the survey used problem-based learning modalities to some degree. However, there was a definite tendency toward traditional lectures and lower-level PBL activities. The range of PBL levels in nearly every case extended from Level 1 to Level 10 or 11. The single exception was the curricular component of medical interviewing, in which no program described instruction using only theoretical learning and traditional lecture (PBL Level 1). The range for medical interviewing began at Level 2 and extended through Level 11.

Problem-based learning was most extensively used in the curricular area of technical procedures and instrumentation, with a mean PBL level of 4.79. The curricular component that was most commonly taught in traditional ways was health policy, with a mean PBL level of 2.27.

The curricular component taught in the most consistent manner across programs was anatomy, with a mean PBL level of 2.82, a variance of 3.216 and a standard deviation of 1.79. The greatest degree of variability across programs was seen in instruction on death and dying, with a mean PBL level of 3.55, a variance of 9.818 and a standard deviation of 3.13.

Table 5

Descriptive Statistics of PBL Activity by Curricular Component

Curricular Component	*N*	Range	Min
Anatomy	33	9	1
Physiology	33	9	1
Pathophysiology	33	9	1
Pharmacology	33	10	1
Health Promotion/ Disease Prevention	33	10	1
Patient Education and Counseling	33	10	1
Human Development	33	10	1
Human Sexuality	33	10	1
Death and Dying	33	10	1
Multicultural Issues	33	9	1
Legal Issues	33	9	1
Professional Practice Issues	33	9	1
Medical Interviewing	33	9	2
Physical Diagnosis	33	10	1
Diagnostic Lab Testing	33	9	1
Tech Procedures/ Instrumentation	33	10	1
Health Policy	33	9	1

Table 5 *(continued)*

Curricular Component	*N*	Range	Min
Psychiatry	33	10	1
Internal Medicine	33	10	1
Primary Care	33	10	1
Surgery	33	10	1
Pediatrics	33	10	1
Obstetrics/ Gynecology	33	10	1
Emergency Medicine	33	10	1
Geriatrics	33	10	1

Table 6

Level of PBL Activity by Curricular Component

	Number of Programs Primarily Using PBL LEVEL										
Component	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11
Anatomy	7	6	16	1	1	0	1	0	0	1	0
Physiology	14	11	3	1	1	0	1	0	1	1	0
Pathophysiology	10	10	5	1	2	0	1	1	0	2	0
Pharmacology	17	4	3	3	3	0	0	1	0	1	1
Health Promotion/ Disease Prevention	7	9	7	2	4	1	0	1	0	1	1
Patient Education and Counseling	6	7	8	2	2	1	1	1	0	2	2
Human Development	11	8	6	2	1	0	0	1	0	2	1
Human Sexuality	11	8	6	2	1	0	0	2	0	1	2
Death and Dying	10	8	5	1	3	0	0	2	1	1	2
Multicultural Issues	7	7	9	2	3	0	1	1	1	2	0
Legal Issues	12	10	4	1	0	0	2	2	1	1	0
Professional Practice Issues	12	8	6	0	2	0	1	1	2	1	0
Medical Interviewing	0	1	18	1	8	0	0	2	0	2	1
Physical Diagnosis	1	1	18	1	7	0	0	2	1	1	1
Diagnostic Lab Testing	4	11	6	3	4	0	2	2	0	1	0

Table 6 *(continued)*

Component	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11
Tech Procedures and Instrumentation	2	0	16	3	4	0	2	1	0	1	4
Health Policy	17	7	4	0	3	0	1	0	0	1	0
Psychiatry	11	9	4	2	2	0	1	0	0	1	2
Internal Medicine	7	7	7	5	2	0	0	2	0	1	2
Primary Care	4	7	7	6	4	0	0	2	0	1	2
Surgery	9	6	7	3	3	0	1	1	0	1	2
Pediatrics	7	9	5	4	3	0	0	2	0	1	2
Obstetrics/ Gynecology	8	9	6	3	2	0	0	2	0	1	2
Emergency Medicine	8	9	7	3	2	0	0	1	0	1	2
Geriatrics	8	7	6	4	3	0	0	1	0	1	2

A Closer Look at the Variation in PBL Levels

Two facts supported by this data seem to be contradictory without further information. It has been said here that there seems to be a definite preference for traditional lectures and lower level PBL activities in the 33 programs of the study. It is also true that the range of PBL levels is large. In nearly every curricular component, the range extended from level 1 to level 10 or 11. What is the true nature of the variation in PBL level?

One explanation of the apparent contradiction above would be the presence of a few extreme outliers in the upper limit of the range. This would have little effect on the mean values of PBL level, which, as discussed earlier, rose no higher than 4.79 (for technical procedures and instrumentation).

A total PBL score was determined for each program, using the sum of the PBL levels for each of the 25 curricular components. Total PBL scores would thus theoretically range from 25 (level 1 in each of the 25 components) to a high of 275 (level 11 in each of the 25 components). In fact, scores in this study ranged from 36 to 250. There were only three programs scoring above 200. It also should be noted that these three programs were indeed extreme outliers. The fourth highest score was 114, far removed from the three highest scores ranging from 218 to 250.

The three highest scoring programs were analyzed separately from the group at large. With regard to demographic data, the group of three was a fairly heterogeneous subset (Table 8). They were each graduate level programs. Aside from the terminal degree granted, there was no other category that showed identical responses from all three programs. In the categories of years of operation, mean student age, gender, and

Table 7

Demographics of Three Programs with Highest PBL Levels

Category	Program A	Program B	Program C
Pass Rate	87.18	76.67	82.61
Mean Score	535	427	456
Degree	Graduate	Graduate	Graduate
Years of Operation	Over 12	Over 12	7 – 9 years
Region	Midwest	Northeast	Eastern
Mean Student Age	21 – 23	24 – 26	21 – 23
Gender	21 – 40 % male	21 – 40 % male	0 – 20 % male
Race	0 – 10 % nonwhite	11 – 20 % nonwhite	0 – 10 % nonwhite

race, one of the three programs provided a different response from the other two. In the category of geographic region, three different responses were given.

These three programs utilized PBL at similar high levels. The aggregate data for the three programs by curricular component is presented in Table 9, and details of the three programs' responses are reproduced in Table 10. One program seemed to provide a set response of Level 10 in all curricular areas, with the other two programs showing more variability (Table 9). The other two programs ranged from a low PBL level of 2 to the maximum level of 11. It is worth noting that not a single PBL level 1 response (traditional lecture and textbook) was given within the responses of these three programs.

Table 8

Descriptive Statistics of Three Programs With Highest PBL Levels

Component	*N*	Range	Minimum	Maximum	Mean	SD	Variance
Anatomy	3	5	5	10	7.33	2.52	6.333
Physiology	3	3	7	10	8.67	1.53	2.333
Pathophysiology	3	3	7	10	9	1.73	3
Pharmacology	3	6	5	11	8.67	3.21	10.333
Health Promot/ Disease Prevent	3	8	3	11	8	4.36	19
Patient Education/ Counseling	3	9	2	11	7.67	4.93	24.333
Human Development	3	1	10	11	10.33	0.58	0.333
Human Sexuality	3	1	10	11	10.67	0.58	0.333
Death and Dying	3	1	10	11	10.67	0.58	0.333
Multicultural Issues	3	1	9	10	9.67	0.58	0.333
Legal Issues	3	6	4	10	7.67	3.21	10.333

Table 8 *(continued)*

	N	Range	Minimum	Maximum	Mean	SD	Variance
Professional Practice Issues	3	1	9	10	9.33	0.58	0.333
Medical Interviewing	3	2	8	10	9.33	1.15	1.333
Physical Diagnosis	3	2	9	11	10	1	1
Diagnostic Lab Testing	3	3	7	10	8.33	1.53	2.333
Tech Proced/ Instrumentation	3	6	4	10	7	3	9
Health Policy	3	7	3	10	6	3.61	13
Psychiatry	3	1	10	11	10.67	0.58	0.333
Internal Medicine	3	1	10	11	10.67	0.58	0.333
Primary Care	3	1	10	11	10.67	0.58	0.333
Surgery	3	1	10	11	10.67	0.58	0.333
Pediatrics	3	1	10	11	10.67	0.58	0.333
Ob/ Gyn	3	1	10	11	10.67	0.58	0.333
Emerg Medicine	3	1	10	11	10.67	0.58	0.333
Geriatrics	3	1	10	11	10.67	0.58	0.333

Table 9

PBL Levels of Three Programs with Highest PBL Utilization

Component	Program A	Program B	Program C
Anatomy	10	5	7
Physiology	10	9	7
Pathophysiology	10	10	7
Pharmacology	10	11	5
Health Promotion/ Disease Prevention	10	11	3
Patient Education and Counseling	10	11	2
Human Development	10	10	11
Human Sexuality	10	11	11
Death and Dying	10	11	11
Multicultural Issues	10	9	10
Legal Issues	10	4	9
Professional Practice Issues	10	9	9
Medical Interviewing	10	8	10
Physical Diagnosis	10	11	9
Diagnostic Lab Testing	10	8	7
Tech Proced/ Instrumentation	10	4	7

Table 9 *(continued)*

Component	Program A	Program B	Program C
Health Policy	10	3	5
Psychiatry	10	11	11
Internal Medicine	10	11	11
Primary Care	10	11	11
Surgery	10	11	11
Pediatrics	10	11	11
Obstetrics/ Gynecology	10	11	11
Emergency Medicine	10	11	11
Geriatrics	10	11	11

High PBL levels were especially evident in the clinical disciplines of psychiatry, internal medicine, primary care, pediatrics, surgery, obstetrics and gynecology, emergency medicine, and geriatrics. In these curricular areas, the three highest scoring programs were consistently teaching at PBL levels of 10 or 11. The mean PBL level for these subject areas was 10.67. Multidisciplinary subject areas such as human sexuality and death and dying were also consistently taught at PBL Level 10 or 11, and a mean PBL level of 10.67 was achieved in each of these areas. There was variation by at least one level in each discipline; no curricular area received an identical response from each of the three programs.

Descriptive statistics for 30 programs, with removal of data for the three highest scoring programs, are presented in Table 11. For the remaining 30 programs, mean PBL levels are slightly lowered for all curricular components with the removal of the three outliers. The procedure-oriented components continue to attain the highest scores in this subset of data. Technical procedures and instrumentation was still the highest scoring curricular component for these 30 programs, with a mean of 4.57. Medical interviewing (mean PBL level = 3.97), physical diagnosis (mean PBL level = 3.73) and patient education and counseling (mean PBL level = 3.43) rounded out the list of highest PBL scores for this subset of programs.

All of these technical and procedural subject areas scored higher than any of the eight clinical disciplines utilizing PBL so extensively in the three outlier programs (psychiatry, internal medicine, primary care, pediatrics, surgery, obstetrics and gynecology, emergency medicine, and geriatrics). The mean PBL levels for these eight subject areas ranged from a low of 2.23 for psychiatry to a high of 3.30 in primary care. The mean PBL score for these eight subject areas was 10.67 uniformly in each of the three outlier programs.

Table 10

Descriptive Statistics of Programs Removing Three Programs with Highest PBL Utilization

Component	N	Range	Minimum	Maximum	Mean	SD	Variance
Anatomy	30	3	1	4	2.37	0.89	0.792
Physiology	30	4	1	5	1.8	1	0.993
Pathophysiology	30	7	1	8	2.27	1.57	2.478
Pharmacology	30	7	1	8	2.13	1.72	2.947
Health Promot/ Disease Prevent	30	7	1	8	2.83	1.74	3.04
Patient Educ and Counseling	30	10	1	11	3.43	2.64	6.944
Human Development	30	7	1	8	2.23	1.55	2.392
Human Sexuality	30	7	1	8	2.47	1.85	3.43
Death & Dying	30	8	1	9	2.83	2.25	5.04
Multicultural Issues	30	7	1	8	2.87	1.76	3.085
Legal Issues	30	7	1	8	2.47	2.13	4.533

Table 10 (continued)

Component	*N*	Range	Minimum	Maximum	Mean	*SD*	Variance
Professional Practice Issues	30	7	1	8	2.37	1.79	3.206
Medical Interviewing	30	9	2	11	3.97	1.81	3.275
Physical Diagnosis	30	7	1	8	3.73	1.53	2.34
Diagnostic Lab Testing	30	7	1	8	3.03	1.73	2.999
Tech Proced/ Instrumentation	30	10	1	11	4.57	2.93	8.599
Health Policy	30	6	1	7	1.9	1.47	2.162
Psychiatry	30	6	1	7	2.23	1.5	2.254
Internal Med	30	7	1	8	2.93	1.84	3.375
Primary Care	30	7	1	8	3.3	1.78	3.183
Surgery	30	7	1	8	2.8	1.83	3.338
Pediatrics	30	7	1	8	2.9	1.88	3.541
Obstetrics/ Gynecology	30	7	1	8	2.73	1.86	3.444
Emergency Med	30	7	1	8	2.57	1.57	2.461
Geriatrics	30	7	1	8	2.67	1.67	2.782

Variation in PANCE Performance Across Programs

For the 33 programs releasing scores for this study, the mean program pass rate and mean program score was analyzed. The average pass rate for the 33 programs was 85.20 %, ranging from a minimum of 44.90% to a maximum of 100% (*SD* = 12.39). The average of PANCE mean score for the 33 programs was 473.21, with a minimum of 384 and a maximum of 566 (*SD* = 49.69).

Table 11

PANCE Pass Rates and Mean Scores

PANCE measure	*N*	Range	Min	Max	Mean	SD	Variance
Pass rate	33	55	45	100	85.2	12.39	153.459
Mean score	33	182	384	566	473.21	49.69	2469.047

A useful value for comparison would be the range of values of pass rates and mean scores for all programs having first-time test takers in 2002. This would help to demonstrate the representative nature of the study programs, as compared to the universe of physician assistant programs nationwide. However, these data were unavailable from the National Commission on Certification of Physician Assistants. The NCCPA would not release data on individual test takers aggregated by program. It was their decision to withhold such program-specific data without the express written consent of each program in question, essentially all accredited programs nationwide. Without such express consent, this request was denied. The exact response from a representative of the NCCPA was, "This frankly is beyond what we would like to share at this time."

Some other sort of proxy variable was sought to place the study variables in context. Individual PANCE scores, not aggregated by program, appeared as published data in the literature and are offered here as substitute values to place the study values in some sort of context. Hooker, Hess, and Cipher published PANCE values from 5 years of examinations, from 1997 to 2001 (Table 13). For that 5-year period, the overall pass rates ranged from 91.5% to 94.9%. The mean scores ranged from 490 to 509. Both the pass rate and the mean score for the programs included in this study are well below the national means for 1997 - 2001 (Hooker et al. 2002).

Table 12

PANCE Annual Scores 1999 - 2001

Year	# of Programs	*N*	Pass Rate	Mean Score
2001	123	4267	91.5 %	490
2000	117	3955	91.6 %	498
1999	104	3810	91.1 %	497
1998	95	3401	94.9 %	509
1997	78	2823	91.6 %	499

Note. Adapted from Hooker RS, Hess B, Cipher D. A Comparison of Physician Assistant Programs by National Certification Examination Scores. *Perspective on Physician Assistant Education*, 13(2) Summer/Autumn 2002.

PBL Level as a Predictor of Success on PANCE Outcome Measures

As discussed in chapter 3, an exploratory principal component analysis was planned for data reduction and to determine which components of the Harden and Davis (1999) typology best explain the variance in PANCE scores. Consultation with a statistician convinced the author that the study group was too small for a meaningful exploratory principal component analysis. It was decided instead to analyze the ordinal data collected using Spearman's rho correlation.

To determine correlation of PBL level with PANCE outcome measures, a new variable was calculated. A total PBL score was determined for each program, using the sum of the PBL levels for each of the 25 curricular components. The total PBL scores would thus theoretically range from 25 to 275; the scores, in fact, ranged from 36 to 250. A Spearman's rho correlation was performed on the PANCE pass rate, the PANCE mean score, the demographic variables, and the new variable total PBL score. The correlation data is presented in Table 14.

There was a strongly positive correlation between PANCE pass rate and PANCE mean score ($r_s = .887, p < .01$), which is expected since they are both derived from the same primary data source: scores of first-time PANCE test takers for a given program. The only general characteristic that demonstrated a statistically significant correlation was the terminal credential offered. The type of degree offered correlated positively with both PANCE pass rate ($r_s = .388, p = 0.26$) and with PANCE mean score ($r_s = .462, p = .007$).

Table 13

Correlation of Demographic Data and Total PBL Score with PANCE Outcome Measures

		pass rate	mean score	degree	# of years	age	gender	race	PBL level
pass rate	r_s	1	.887(**)	.388(*)	0.067	-0.116	-0.245	-0.252	0.032
	Sig.	.	0	0.026	0.711	0.52	0.169	0.165	0.86
	N	33	33	33	33	33	33	32	33
mean score	r_s	.887(**)	1	.462(**)	0.021	-0.18	-0.261	-0.304	0.121
	Sig.	0	.	0.007	0.907	0.315	0.142	0.091	0.503
	N	33	33	33	33	33	33	32	33
Degree	r_s	.388(*)	.462(**)	1	0.255	-0.141	.365(*)	-.437(*)	0.032
	Sig.	0.026	0.007	.	0.152	0.433	0.037	0.012	0.859
	N	33	33	33	33	33	33	32	33
# years	r_s	0.067	0.021	0.255	1	-0.175	-0.222	-0.082	0.046
	Sig.	0.711	0.907	0.152	.	0.331	0.214	0.655	0.801
	N	33	33	33	33	33	33	32	33

Table 13 *(continued)*

		pass rate	mean score	degree	# years	age	gender	race	PBL level
age	r_s	-0.116	-0.18	-0.141	0.175	1	0.149	0.255	-0.274
	Sig.	0.52	0.315	0.433	0.331	.	0.409	0.159	0.123
	N	33	33	33	33	33	33	32	33
gender	r_s	-0.245	-0.261	-.365(*)	0.222	0.149	1	0.191	0.035
	Sig.	0.169	0.142	0.037	0.214	0.409	.	0.296	0.847
	N	33	33	33	33	33	33	32	33
race	r_s	-0.252	-0.304	-.437(*)	0.082	0.255	0.191	1	0.278
	Sig.	0.165	0.091	0.012	0.655	0.159	0.296	.	0.124
	N	32	32	32	32	32	32	32	32
PBL	r_s	0.032	0.121	0.032	0.046	-0.274	0.035	0.278	1
Level	Sig.	0.86	0.503	0.859	0.801	0.123	0.847	0.124	.
	N	33	33	33	33	33	33	32	33

Note. * Correlation is significant at the .05 level (2-tailed). ** Correlation is significant at the .01 level (2-tailed).

Other demographic variables (years of operation, mean age, gender, and race) had no statistically significant correlation with either PANCE pass rate or mean score. Geographic region was not included in the correlation matrix due to the nominal data provided in that category.

The correlation of PBL activity with PANCE outcomes was most relevant to the research question under investigation. The data indicated that there was no significant correlation between a program's certification exam pass rate and its total PBL score ($r_s = .032, p = .860$). Similarly, there was no significant correlation between a program's PANCE mean score and its total PBL score ($r_s = .121, p = .503$).

An analysis of variance of PANCE outcomes across groups stratified by PBL levels was performed using SPSS. The programs in the study were sorted based upon the new calculated variable, total PBL score. The lowest scoring programs were coded 1, the midrange programs were coded 2, and the highest scoring programs were coded 3. Using this code, the programs were stratified into low-, medium-, and high-PBL groups. Differences in mean scores and pass rates were sought across these three groups. The ANOVA results (Table 12) demonstrated that there was no significant difference in the PANCE pass rate between low-, medium-, and high-PBL groups ($F = 1.625, p = .214$). Similarly, there was no significant difference in the PANCE mean score between low-, medium-, and high-PBL groups ($F = 1.921, p = .164$).

The null hypotheses stated that there is no significant difference in either of the dependent variables of PANCE pass rate and PANCE mean score considering PBL activity as the independent variable. The data supports acceptance of the null hypothesis in both instances.

Table 14

ANOVA of Pass Rate and Mean Score Between Low-, Medium- and High-PBL Groups

PANCE measure		Sum of Squares	*df*	Mean Square	*F*	Sig.
pass rate	Between Groups	480	2	240	1.625	0.214
	Within Groups	4430.69	30	147.69		
	Total	4910.689	32			
mean score	Between Groups	8970.683	2	4485.342	1.921	0.164
	Within Groups	70038.832	30	2334.628		
	Total	79009.515	32			

Disaggregation of the PBL Level Variable

Further analysis using SPSS was attempted by disaggregating total program PBL levels by curricular component. Curricular component PBL level was used as an independent variable and PANCE exam outcomes were used as dependent variables in an ANOVA. Four curricular components had statistically significant differences in PANCE pass rates based upon PBL level. The four curricular components were death and dying

(Table 16, $F = 2.729$, $p = 0.027$), multicultural issues (Table 17, $F = 3.99$, $p = 0.004$), professional practice issues (Table 18, $F = 2.692$, $p = 0.032$) and psychiatry (Table 19, $F = 2.695$, $p = 0.032$).

Levene's test for homogeneity of variance was performed within SPSS for each of these four components. Levene's statistic was significant in the areas of death and dying, multicultural issues and professional practice issues; therefore, homogeneity of variances cannot be assumed for these curricular components. There may still be a statistically significant difference in program pass rates based on the PBL level of instruction in these three areas; however, reliability of the ANOVA is questionable with a statistically significant Levene's test and the inability to assume equal variances in these three areas.

In the fourth area, psychiatry, Levene's statistic was not significant and therefore homogeneity of variances can be assumed. It can be concluded from this data that there is a statistically significant difference in PANCE pass rates based on the PBL level used in teaching psychiatry. However, Tukey's post-hoc test could not be performed by the SPSS program due to two of the PBL levels having fewer than two cases. PBL level 7 and level 10 were each used by only one program of the study.

Although the limitations of the post-hoc testing in SPSS prevented conclusive statements about causality, it would appear from the data that teaching psychiatry using PBL level 4 (problem-solving learning) or level 5 (problem-focused learning) is associated with higher program pass rates on the PANCE.

Table 15

Death and Dying PBL Levels

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
mean	1	10	475.4	48.52	15.34	440.69	510.11	386	566
score	2	8	460.38	61.87	21.87	408.65	512.1	384	552
	3	5	465.6	25.07	11.21	434.48	496.72	440	499
	4	1	391	.	.	.	.	391	391
	5	3	485.33	43.88	25.33	376.33	594.33	436	520
	8	2	524	14.14	10	396.94	651.06	514	534
	9	1	538	.	.	.	.	538	538
	10	1	535	.	.	.	.	535	535
	11	2	441.5	20.51	14.5	257.26	625.74	427	456
	Total	33	473.21	49.69	8.65	455.59	490.83	384	566

Table 15 *(continued)*

		N	Mean	Std Deviation	Std Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
pass rate	1	10	86.29	9.55	3.02	79.46	93.12	73	100
	2	8	82.91	14.71	5.2	70.62	95.21	61	98
	3	5	85.09	5.53	2.47	78.23	91.95	79	94
	4	1	44.9	.	.	.	.	45	45
	5	3	91.98	6.5	3.75	75.83	108.12	85	96
	8	2	97.44	3.63	2.56	64.84	130.03	95	100
	9	1	97.78	.	.	.	.	98	98
	10	1	87.18	.	.	.	.	87	87
	11	2	79.64	4.2	2.97	41.9	117.38	77	83
	Total	33	85.2	12.39	2.16	80.81	89.59	45	100

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mean score	1.645	8	24	0.164
pass rate	2.688	8	24	0.029

Table 15 *(continued)*

ANOVA

		Sum of Squares	df	Mean Square	*F*	Sig.
mean score	Between Groups	24040.873	8	3005.109	1.312	0.285
	Within Groups	54968.642	24	2290.36		
	Total	79009.515	32			
pass rate	Between Groups	2339.081	8	292.385	2.729	0.027
	Within Groups	2571.608	24	107.15		
	Total	4910.689	32			

Table 16

Multicultural Issues PBL Level

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
mean	1	7	478.57	57.52	21.74	425.38	531.77	386	566
score	2	7	437.29	41.88	15.83	398.56	476.01	384	494
	3	9	473.89	37.49	12.5	445.07	502.71	436	552
	4	2	522.5	3.54	2.5	490.73	554.27	520	525
	5	3	517.33	19.22	11.1	469.59	565.07	500	538
	7	1	534	.	.	.	.	534	534
	8	1	391	.	.	.	.	391	391
	9	1	427	.	.	.	.	427	427
	10	2	495.5	55.86	39.5	-6.4	997.4	456	535
	Total	33	473.21	49.69	8.65	455.59	490.83	384	566

Table 16 (continued)

		N	Mean	Std Deviation	Std Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
pass rate	1	7	86.87	10.21	3.86	77.43	96.32	75	100
	2	7	79.58	13.17	4.98	67.4	91.75	61	94
	3	9	85.84	7.28	2.43	80.24	91.43	73	97
	4	2	97.42	1.5	1.06	83.95	110.89	96	98
	5	3	95.9	1.63	0.94	91.86	99.95	95	98
	7	1	100	.	.	.	.	100	100
	8	1	44.9	.	.	.	.	45	45
	9	1	76.67	.	.	.	.	77	77
	10	2	84.9	3.23	2.29	55.86	113.93	83	87
	Total	33	85.2	12.39	2.16	80.81	89.59	45	100

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mean score	1.253	8	24	0.313
pass rate	3.457	8	24	0.009

Table 16 *(continued)*

ANOVA

		Sum of Squares	df	Mean Square	*F*	Sig.
mean score	Between Groups	33521.817	8	4190.227	2.211	0.064
	Within Groups	45487.698	24	1895.321		
	Total	79009.515	32			
pass rate	Between Groups	2803.05	8	350.381	3.99	0.004
	Within Groups	2107.64	24	87.818		
	Total	4910.689	32			

Table 17

Professional Practice Issues PBL Level

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
mean	1	12	475.83	49.16	14.19	444.6	507.07	386	566
score	2	8	463.13	58.33	20.62	414.36	511.89	384	552
	3	6	473.5	36.83	15.04	434.85	512.15	436	520
	5	2	508.5	41.72	29.5	133.67	883.33	479	538
	7	1	391	.	.	.	.	391	391
	8	1	534	.	.	.	.	534	534
	9	2	441.5	20.51	14.5	257.26	625.74	427	456
	10	1	535	.	.	.	.	535	535
	Total	33	473.21	49.69	8.65	455.59	490.83	384	566

Table 17 (continued)

		N	Mean	Std Deviation	Std Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
pass rate	1	12	85.83	10.15	2.93	79.38	92.27	73	100
	2	8	83.86	13.97	4.94	72.17	95.54	61	97
	3	6	89.54	6.23	2.54	83.01	96.08	83	96
	5	2	91.1	9.45	6.68	6.22	175.98	84	98
	7	1	44.9	.	.	.	.	45	45
	8	1	100	.	.	.	.	100	100
	9	2	79.64	4.2	2.97	41.9	117.38	77	83
	10	1	87.18	.	.	.	.	87	87
	Total	33	85.2	12.39	2.16	80.81	89.59	45	100

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mean score	1.162	7	25	0.359
pass rate	2.518	7	25	0.042

Table 17 *(continued)*

ANOVA

		Sum of Squares	df	Mean Square	*F*	Sig.
mean score	Between Groups	19670.473	7	2810.068	1.184	0.347
	Within Groups	59339.042	25	2373.562		
	Total	79009.515	32			
pass rate	Between Groups	2110.704	7	301.529	2.692	0.032
	Within Groups	2799.985	25	111.999		
	Total	4910.689	32			

Table 18

Psychiatry PBL Levels

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
mean	1	12	473.75	48.47	13.99	442.96	504.54	386	566
score	2	9	472.56	62.77	20.92	424.31	520.81	384	552
	3	4	463.75	29.17	14.59	417.33	510.17	436	499
	4	2	494	36.77	26	163.64	824.36	468	520
	5	2	513	18.38	13	347.82	678.18	500	526
	7	1	391	.	.	.	.	391	391
	10	1	535	.	.	.	.	535	535
	11	2	441.5	20.51	14.5	257.26	625.74	427	456
	Total	33	473.21	49.69	8.65	455.59	490.83	384	566

Table 18 (continued)

		N	Mean	Std Deviation	Std Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
pass rate	1	12	85.8	9.63	2.78	79.68	91.91	73	100
	2	9	84.36	14.01	4.67	73.59	95.13	61	100
	3	4	88.98	5.86	2.93	79.65	98.3	83	94
	4	2	90.23	8.68	6.13	12.27	168.18	84	96
	5	2	97.53	3.49	2.47	66.15	128.91	95	100
	7	1	44.9	.	.	.	.	45	45
	10	1	87.18	.	.	.	.	87	87
	11	2	79.64	4.2	2.97	41.9	117.38	77	83
	Total	33	85.2	12.39	2.16	80.81	89.59	45	100

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mean score	1.62	7	25	0.176
pass rate	1.632	7	25	0.172

Table 18 *(continued)*

ANOVA

		Sum of Squares	df	Mean Square	*F*	Sig.
mean score	Between Groups	16983.793	7	2426.256	0.978	0.469
	Within Groups	62025.722	25	2481.029		
	Total	79009.515	32			
pass rate	Between Groups	2112.05	7	301.721	2.695	0.032
	Within Groups	2798.639	25	111.946		
	Total	4910.689	32			

In answer to Research Question One, PBL was not extensively used in the PA Programs participating in this study. PA educators tend to teach across all disciplines with lower PBL level activities such as the traditional lecture and textbook. Some subjects (highly practical or procedural disciplines) were exceptional in their utilization of higher levels of PBL instructional modalities. Research Question Two revealed a minor difference in educational outcomes based upon PBL activities. A program's curriculum, when taken as a whole, produced no significant differences in PANCE outcomes based on PBL activity. However, when program scores were disaggregated to consider each subject separately, PANCE outcomes seemed to be significantly affected when problem-based learning methods are used in the teaching of death and dying, multicultural issues, professional practice issues, and psychiatry.

Chapter V

Discussion

Several valid conclusions can be drawn from this study; however, there are significant limitations that are immediately apparent. It would be prudent, therefore, for any practitioner of higher education to consider the caveats presented here as well. The discussion will outline the limitations of the present study, and will move on to suggest implications for practice to both PA educators and the larger enterprise of higher education in general. The discussion concludes with consideration of the implications for future study of problem-based learning in higher education in general, and specifically in the education of the physician assistant student.

Summary

The first part of the research question sought to evaluate the current level of utilization of PBL in the universe of physician assistant education. The descriptive statistics presented here indicate that preferred instructional modalities in all curricular areas are skewed toward more traditional methods and away from more problem-based methods. Though all programs participated to some degree in problem-based learning activities, it remains the exception rather than the norm.

It is also noted that high levels of problem-based learning tend to be sequestered within certain curricular areas. There was more PBL activity in characteristically hands-on curricular components such as technical procedures and instrumentation, medical interviewing, and physical diagnosis. These curricular components have a problem-based orientation by their very nature; it is unlikely that any program would teach this material in a solely theoretical manner.

The study is further limited by the complex nature of the survey matrix. It was time-consuming to become familiar with the variables as they were operationalized here, and there was some risk of error or misinterpretation. It may be advantageous in the future to undertake qualitative research into actual classroom activities, rather than rely on questionnaire responses. The primary investigator would then be able to observe the activities that are being referred to as PBL, rather than rely on the interpretation of another. This would get inside of Hak and Maguire's black box in a more informative way, and would help eliminate potential interrater variation from program to program which is inherent in survey responses (Hak & Maguire, 2000).

One risk to the internal validity of this study is that the group of students who took the certification examination in 2002 was not identical to the 1st-year students specifically addressed in the survey. The 1st-year students discussed in the survey would not be eligible to take the PANCE until the 2003 testing window at the earliest. It cannot be assumed that the 1st-year class will be without significant variation from year to year. Any significant variation in gender, race, age, or other factor unmeasured here may present confounding variables in determining effect on PANCE outcome measures. It also cannot be assumed that the curriculum remained identical from year to year. If there was any change in instructional modality, especially where problem-based learning is concerned, the validity of the results is compromised.

It was also noted that, although largely representative of national trends, the study group differed from national expected values in two significant areas. The first area of difference, mean age of the didactic-phase student body, may have skewed the results of the descriptive statistics presented here. It is a widely held opinion that PBL is particularly helpful for adult learners. Is a study population possessing a lower mean student age set up for unsuccessful efforts in the andragogy that is inherent in problem-based learning? Is there an older subculture in PA education, undiscovered by the present study, which is having more marked success in PBL? Malcolm Knowles and other researchers of adult learning behavior would very likely argue the affirmative.

The study group also differed from national expected values with regard to scores on the national certifying examination. The responding programs in this study seemed to have lower pass rates and lower mean scores than national statistics published for prior years. This could mean that there are very successful programs that chose not to participate in the survey, or chose not to divulge their program's results on the PANCE. Several of these successful programs may be utilizing PBL, to their benefit. Since this research design blinded the researcher to the identity of specific programs, this assertion cannot be made with certainty. However, future research could address this shortcoming, perhaps with greater efforts toward a representative sampling of accredited programs rather than an ambitious attempt at a census of them all.

The second part of the research question was intended to determine the effect of problem-based learning activities on objective outcome measures, namely a program's pass rate and mean score on the Physician Assistant National Certifying Examination (PANCE). In this study, statistical analysis demonstrated that there is no significant correlation between problem-based learning activities in a program and that program's mean score on the PANCE. Likewise, there is no significant correlation between problem-based learning activities in a program and that program's pass rate on the PANCE.

An ANOVA demonstrated that there is no significant difference in PANCE mean scores when programs are stratified into high-, medium-, and low-PBL groups. Likewise, there is no significant difference in PANCE pass rates when programs are stratified into high-, medium-, and low-PBL groups. This means that when taking a program's curriculum as a whole, PANCE outcomes were not significantly different whether curriculum was primarily delivered via traditional lectures and texts, via problem-based learning, or by some hybrid of these two extreme instructional modalities.

With disaggregation of the data, some significant differences were seen. When PBL level in a single curricular component was used as an independent variable, significant differences in PANCE pass rate were seen. However, the effect was not linear. It cannot be said that increasing levels of PBL instruction is associated with increasing PANCE pass rates. In fact, where PBL level was seen to have a statistically significant impact, it was instruction using medium-PBL levels (specifically, Level 5 and Level 6), which seemed to be associated with the highest pass rates on PANCE.

The effect was also not reproduced from curricular component to curricular component. It cannot be said that PBL levels 5 and 6, wherever utilized in the curriculum, increased PANCE pass rates for a given program. Different subject areas seemed to benefit from different types of instruction. Whereas psychiatry instruction seemed to benefit from problem-based instruction, it is very likely due to the unique needs of the discipline of psychiatry and behavioral sciences where clinical cases and problem solving are indispensable to learning principles of the discipline.

The null hypothesis under investigation stated that the level of PBL activity in the curriculum of physician assistant programs is associated with no significant difference in educational achievement. The null hypothesis has proven to be true in this case. Problem-based learning activity, across a wide array of curricular components, is not a reliable predictor of educational achievement when operationalized as performance on a standardized examination such as the PANCE. The findings in this study are consistent with Colliver's (2000a) literature review on PBL in medical school curricula, which was found to have little demonstrable effect on objective outcome measures. Indeed, the findings are consistent with most research into educational innovations, such as Dubin and Taveggia's analysis of 91 studies from 1924 to 1965. They compared different instructional methods and again found no significant effect on student performances on standardized tests (Dubin & Taveggia, 1968).

Discussion

I would mention again Russell's optimistic view despite a growing number of equivocal findings in "The No Significant Difference Phenomenon" (Russell, 2001, p. xiii). A finding of no significant difference implies no harm as well as no benefit. Russell advocated advances in distance learning despite the apparent lack of improvement in objective outcome measures. Similarly, problem-based learning remains a useful endeavor if there is no detriment to objective outcome measures and there is a reasonable expectation of some other benefit, as yet unmeasured. This may include improved communication and interpersonal skills, more favorable evaluations from clinical preceptors or employers, or enhanced confidence levels in diagnosing disease and treating patients. None of these more intangible characteristics are measured on the PANCE, yet all are valuable assets to the nascent health care practitioner. Further study is warranted to determine the effect of PBL on different domains of learning. It is likely that PBL will affect the learner in ways difficult to measure by standardized tests.

The study is limited by its small response rate, despite aggressive follow-up with program directors in the form of a second mailed survey to nonresponders with electronic mail follow-up. One likely cause is the growing number of surveys that cross a program director's desk. With a large number of PA programs either recently founded as master's level programs or recently converting to master's degree granting programs, there is an increased emphasis on research activities by students enrolled in PA programs. Research on PA educational programs is seen as involving a convenience population of program directors who have traditionally been eager to help researchers, particularly student researchers. Too often, high caliber surveys commingle in a program director's in box with surveys of more dubious value and academic rigor. Some directors may justifiably choose to disengage from the process altogether.

Another factor that may be adversely affecting return rate is a recent push in the higher education community for some degree of quality assurance in physician assistant education. The first step in this recent posture was the "Blue Ribbon Panel Report on Physician Assistant Program Expansion" (Carter, Cawley, Fowkes, Hooker, Rackover and Zellmer, 1998). This represented an effort of the Association of Physician Assistant Programs to address the explosive growth in number of PA programs in the 1990s. The

Report ended by making recommendations to the APAP membership. They included the establishment of a Work Force Planning Group to plan future program expansion based upon supply and demand models and the development of additional standards for accreditation that better reflect outcome measures. One recommendation asked to "establish a work group to develop collective strategies for reducing the number of PA graduates by 10%, 20%, or 25% if the supply of PAs begins to outpace demand in specific regions" (Carter et al., 1998, p. 28).

This was followed months later by a statement from the APAP Board of Directors. This communication detailed the progress made toward accomplishing the recommendations of the Blue Ribbon Panel. Plans were made to collaborate with the Council on Graduate Medical Education, which has already been engaged in the study of physician workforce issues. Accreditation issues had been referred to the existing APAP Accreditation Taskforce and credentialing issues were referred to a newly created APAP Degree Taskforce.

Stein and Pedersen revealed that one of the recommendations, a call for reduction in the number of graduates by up to 25%, was highly problematic for the Board of Directors. They wrote, "(l)egal counsel has recommended we not discuss, consider, or adopt this specific activity due to its implication of restraint of trade." Within the same communication, the Board cautioned all stakeholders that "(c)are must be exercised . . . as our tax-exempt reason for existence revolves around providing for the public good, not protecting the profitability of our graduates" (Stein & Pedersen, 1998, p. 157).

A new twist was added to this story of a group of educators already growing more self-protective with the passing months. For the third time, the U.S News and World

Report included graduate-level PA programs in its ranking of the top graduate health professions schools across the country. Some schools were pleased with their ranking, even to the point of using this information in the recruitment of applicants. Duke University, consistently ranked number one in this survey, places a link to the report prominently on its Internet home page (http://pa.mc.duke.edu).

Others are not so pleased with this survey and its implications. In his article in APAP Update, James Cawley discussed the "distinct ambivalence" of PA educators with regard to these rankings (Cawley, 2003, para. 6). The methodological shortcoming he described includes a misguided emphasis on "reputation scores" which are tantamount to a popularity contest (Cawley, 2003, para. 2).

Cawley (2003) also faulted the magazine for its consideration of only graduate-level PA programs. There is no consensus on what attributes make a quality PA Program. In fact, a case could be made for higher quality in an associate or baccalaureate degree program that expends a greater share of resources to aid disadvantaged students in their academic endeavors. This highly admirable quality would be lost to the readers of the U.S. News and World Report graduate-level program rankings.

Eugene Jones has advocated some sort of ranking of PA programs, but he is not convinced that the reputation scores used in the U.S. News and World Report ranking is the best outcome variable. Rather, he would favor variables such as average length of accreditation awarded, mean applicant-per-seat ratios, mean FTE faculty to student ratios, mean faculty and staff turnover rates. It is important to note that Jones believes that mean first-time PANCE scores and pass rates are among the quantifiable elements that may relate to program quality (Jones, 1999).

It is my contention that, in the current climate of ranking by reputation, growing defensiveness, and fear of a contracting educational market, program directors are less willing than ever to disclose outcome measures such as PANCE pass rates and mean scores. This very likely has adversely affected the response rate of this study and may even have colored the responses of those who did participate. In another time, with some of these contentious matters settled, a more stable universe of physician assistant educators would be more inclined to disclose outcome variables. Then, both favorable and unfavorable data would be more freely shared in the interest of the larger endeavor of improving allied health education and producing quality healthcare practitioners.

Implications for Practice: Physician Assistant Educators

The physician assistant program directors responding to this survey will reap some benefit from their participation. Recognizing their contribution to the study by providing access to sensitive certification exam scores, I offer several recommendations for their educational practice flowing from this study's findings.

First, the diverse PBL activities in the universe of PA education is expected and is very likely beneficial. Writing in the Chronicle of Higher Education, Patel and Kaufman (2001) stated that "there is a tension between medicine as a science taught traditionally and medicine as a craft best taught via apprenticeship and supervised practice" (p. B12). Each program should determine for itself the appropriate mix of traditional and case-based learning. Such a flexible strategy will produce the greatest student achievement across several institutional types, for all types of students and variation in faculty characteristics as well.

Secondly, the lack of demonstrated improvement on the PANCE exam should not discourage its use. Norman and Schmidt (2000) asserted that a curriculum that is more challenging, motivating, and enjoyable has intrinsic worth even in the absence of measurably improved outcomes. Clyde F. Herried, a distinguished teaching professor in biology at the State University of New York at Buffalo, colorfully compared the team building in case-based education to the efforts of sports teams and the leadership of great coaches such as Penn State's Joe Paterno and Vince Lombardi of the Green Bay Packers. In an essay for the Journal of College Science Teaching, Herried even went so far as to say that students love what they do in a problem-based learning environment (Herreid, 2000).

When distinguished teaching professors such as Herried are moved to use terms such as love in describing students' responses to an educational intervention, the problem of measuring such problematic and subjective outcome variables is immediately apparent. The solution to the problem lies in more subjective and interpersonal measures such as: (a) case-based testing of problem-solving skills, (b) student self-assessment, (c) comments from peers and classmates, (d) evaluations by clinical preceptors, (e) interviews with employers of new graduates, and (f) patient satisfaction surveys. This will investigate the hypothesized true nature of the benefit of PBL and also help to foster recent trends in a more humanistic character to health sciences education.

Third, for those programs tending toward little or no PBL use, I would recommend expanded use of the technique. This is not to encourage noncommittal trials of novel educational modalities. John J. Sparkes (1999) discouraged such trial and error, which he felt does students a great disservice. He asked educators to adopt the mindset of practitioners of engineering, medicine and law, where such a trial-and-error mentality is unacceptable. He advocated instead a rational assessment of both learning and teaching to "get it right the first time," with varied methodologies in place which anticipate and meet the needs of diverse learners (p. 188). His formula for successful learning-centered teaching is an organized, planned, and appropriate use of both traditional lectures (the "sage on the stage") and problem-based learning (the "guide on the side") (p. 183).

Implications for Practice: Higher Education

In the research involving problem-based learning, much attention has been focused, both here and elsewhere, on schools of medicine and health sciences. However, the recommendations for practice in the previous section transcend discipline. They are highly applicable for most tertiary educational settings and are not limited to medicine and the health sciences. A variety of PBL activities may be custom-fit to the needs of disparate disciplines. As was the case in medical education, success will be best measured by means other than high-stakes, objective tests. Advance planning is paramount to insure the problem-based cases are tied to existing course goals and objectives. Assessment should be appropriate, and should involve some subjective measures and case-based problem-solving testing as well. Some degree of institutional support is necessary from the outset, including financial support, instructional technology, and the training of PBL facilitators.

I would like to conclude this section of the discussion with a description of some successful applications of PBL found in the literature of other disciplines. Undergraduate education in the sciences is leading the way. This is probably due to the fact that many science majors aspire to study medicine or other disciplines within the health professions, and responsible science educators wish to prepare these students for the challenges of their future professional education.

Stanley and Waterman (2000) cited the American Association of Community Colleges in stating that within 5 years, the typical undergraduate taking biology will be over the age of 25, working, and enrolled in a 2-year college. For this reason, they began to collaborate with 2-year college faculty in developing a program called LifeLines OnLine. These are curriculum modules presented via the Internet in a form resembling articles in an electronic newspaper. In one example, an article about a corn epidemic led groups of students to investigate specific diseases of corn, crop management strategies, and the role of weather in the spread of blights. This integrates student interest and real-world scenarios into the biological sciences, and emphasized the role of science in solving problems (Stanley & Waterman, 2000).

In a sophomore chemistry class at Emory University, students were asked to solve another real-world problem. A guest lecturer from an environmental advocacy group "hired" students to use published EPA protocols in analyzing water samples from a nearby river. Through the use of self-evaluation logs, oral presentations, and postings to an electronic bulletin board, students demonstrated a developing sense of responsibility, an appreciation for the scientific approach to problem solving, and a fostering of group dynamics and collaborative skills (Ram, 1999).

Allen and Rooney at Western Michigan University took a unique approach to the teaching of Business Communication. In a single course, both ESL students and native speakers of English worked in collaborative groups to solve crises linked to realistic business problems. One example in the article was the need to communicate the discovery of sweatshop conditions to the shareholders of a hypothetical corporation. The students generate proposals, reports and memos germane to the crisis while using sound principles of business communication. The researchers assert that this type of instruction gives ESL students "the confidence and experience they need to communicate and compete successfully in other courses" (Allen & Rooney, 1998, p. 54).

The last article addressed two significant features of increased access to higher education: distance learning technology and the concept of the Open University. Both of these innovations are beneficial to the nontraditional, adult learner. Researchers at the Open University of Hong Kong hoped to demonstrate that the use of PBL could result in greater success for the adult learner. Experienced administrators of distance learning were asked to incorporate problem-based learning into their courses. They were then interviewed to determine their view of the experience. This was an exploratory and qualitative study, and some of the concerns voiced have already been mentioned here. They believed that the incorporation of PBL into course materials would involve great commitment, from management down, which was not part of this trial. PBL needs to remain flexible, with group work existing alongside the independent work that is characteristic of a nontraditional student engaging in asynchronous distance learning. The facilitator's methodology must change as well in distance-learning PBL. The facilitator would be required to adopt novel ways of interacting with students and groups, most often using electronic bulletin board postings or through prerecorded voicemail messages (Taplin, 2000).

Implications for Future Study

After careful reflection on the findings of this study, it is apparent that several things could have been done differently to increase its value to the higher education community. If there was a more qualitative aspect to the study, it could have produced a richer description of exactly what occurs in a PBL classroom. This could have involved audio or video recordings or diary entries documenting activities within the black box. In the brief time it takes to complete a survey, an average program director might have had difficulty fitting their classroom activities into one of Harden and Davis's (1999) narrowly defined PBL levels.

There are several outcome measures which would likely show greater effect size as a result of PBL. In retrospect, the use of subjective preceptor evaluations or students' problem-solving activities would have been preferable dependent variables. These variables could have been measured with the cooperation of participating program directors completing ancillary survey materials or forwarding them to students and preceptors.

The variables chosen here (PANCE pass rate and mean score) are of limited usefulness; however, different choices in future studies may shed more light on academic achievement for PA students. This study has in essence replicated what has been discovered in the literature for medical schools; namely, that PBL activities have little effect on objective outcome measures such as test scores. The investigations can continue from here to advance the dialogue.

Roderick Hooker et al. conducted a study that showed that a number of program characteristics (age, gender, institutional type, degree offered, Carnegie classification, class size, duration of program, and cost of tuition) had no meaningful association with PANCE performance. Problem-based learning activity was not considered. However, his data confirmed that future research should focus on different domains of educational outcomes (Hooker et al., 2002). Outcomes more likely to be affected by problem-based learning may include personality profiles, problem-solving ability, interpersonal skills, and subjective evaluations by preceptors, patients, or first employers.

It is worth noting that many of these alternative outcome measures (clinician's personality profile or interpersonal skills) are vital to the practice of psychiatry. Psychiatry was the area of inquiry that seemed to benefit most from problem-based learning activities. If the effect size of PBL activity is to be accurately measured, and some of Hooker's alternative outcome measures are used in future studies, an even greater positive impact could be expected in practitioners of psychiatry and behavioral medicine.

Information on PBL may well be included in the next annual survey of PA Programs. It is a well-established investigation that is undertaken annually, now entering its 20th cycle. This survey has a remarkably high response rate, largely due to its prominent stature in the eyes of physician assistant educators. The survey is relatively comprehensive; however, questions addressing problem-based learning activities nationwide could easily be incorporated.

As a next step in the investigation of PBL in physician assistant education, I would propose a study with a significant qualitative element. It would involve writing an ethnography of as many PBL classrooms as is possible and practical. This would not be possible in 130 accredited PA programs, so a careful selection of a representative population for study would be key. Field notes, recorded by a participant-observer engaged in the PBL process, could provide a glimpse into the black box of PBL that is unprecedented in its rich detail. This data could be supplemented by interviews of the students and facilitators. Real-time interviews could provide an opportunity to define terms and clarify and focus responses. This clarity was not available in the present study, with its detailed, yet confusing, survey matrix.

Dubin and Taveggia asserted that "nothing new will be discovered about college teaching methods until we ask new questions and seek their answers in research which departs significantly from that pursued in the past" (Dubin & Taveggia, 1968, p. 51). The present dissertation was necessary to determine if the equivocal outcomes found by Jerry Colliver would be replicated in the PA universe. However, if the dialogue concerning PBL is to proceed, I believe a qualitative study is necessary to discover and document the elusive subjective outcomes that have long been suspected to be improved through problem-based learning.

In chapter 2, Stark and Latucca's (1997) five major debates in higher education were summarized. Yet this dissertation is intensely focused on one of these: evaluation and quality control. Investigation should proceed into PBL and its impact on the other ongoing debates. With regard to educational purpose, which level of PBL is the most efficient means to enhance a practical, utilitarian curriculum? Regarding diversity of learners, does PBL enhance the educational achievement of non-traditional or educationally disadvantaged learners? With regard to content, does PBL incorporate the most timely, relevant and evidenced-based fund of knowledge into a given curriculum? Lastly, regarding process, can PBL or any instructional innovation truly make a difference in educational outcomes? The work of Dubin and Taveggia (1968), Russell and his "No Significant Difference" phenomenon (2001), and a growing body of literature concerning PBL gives us reason for doubt. Still, innovations will continue to loom on the horizon; it is incumbent upon the educational researcher to investigate each with due diligence and ceaseless optimism that a difference can be made.

Problem-based learning was designed to remedy a problem of transfer of learning within medical schools. It was noted that students uniformly appeared to have forgotten a significant portion of their preclinical didactic knowledge, even when examinations on the subject had been passed earlier. The PBL approach involves an integration of preclinical and clinical courses. An interdisciplinary team of faculty carefully designs a series of problems, usually in the form of case studies. Groups of students are then required to discuss each problem, make inquiries as the problem dictates, produce tentative explanations for each aspect of the problem, and devise courses of action. It is thought to be part of a whole curricular approach, and not just a teaching technique. It is theorized that the group process involved, with its self-directedness and contextual nature of learning, fosters the critical thinking, clinical reasoning, and lifelong learning necessary for the practice of medicine in current times. PBL more closely resembles the work they will be doing upon entering the profession, and also bears a similarity to the process most commonly used by professionals in practice. As is the case with other innovations, theory awaits definitive proof of significantly improved outcomes.

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Appendix A

Survey Instrument

(on Seton Hall University letterhead)

Dear Program Director:

My name is Gary Bouchard. I am a doctoral candidate seeking a Ph.D. in Higher Education Administration from the Department of Educational Administration and Supervision at Seton Hall University.

As part of the dissertation process, I have designed the following survey to 1) assess the types of problem-based learning occurring in Physician Assistant programs nationwide and 2) determine the effect of PBL activities on average scores on the PA National Certifying examination. Your participation in this study will involve the completion of a survey that should take no more than thirty minutes.

The matrix survey which follows ("Problem-based Learning in PA Education") will ask you to identify which of the eleven choices provided best represents your program's predominant teaching modality in several subject areas. For example, if your Human Anatomy instruction is best characterized by formal lectures which include some practical or clinical information, your best choice would be line 2 of the matrix. If formal lectures in human anatomy are followed by practical laboratory experience, your best choice would be line 3 of the matrix. A few brief questions concerning the demographic makeup of your program follow the matrix survey.

Your participation is voluntary. There are no risks or benefits involved in participation.

Survey results will be sent in tabular form to the NCCPA, and average PANCE scores will be added to your program data. To maintain confidentiality, the NCCPA will be asked to replace the name of your program with a numerical identifier when providing average PANCE scores.

Data will be stored in a locked cabinet in the offices of the investigator.

Please direct all inquiries to Gary J. Bouchard at bouchaga@shu.edu or by regular mail through the Ph.D. Program in Higher Education Administration, Department of Educational Administration and Supervision, Seton Hall University, 400 South Orange Avenue, South Orange, New Jersey 07079.

This project has been reviewed and approved by the Seton Hall University Institutional Review Board for Human Subjects Research. The IRB believes that the research procedures adequately safeguard the subject's privacy, welfare, civil liberties, and rights. The Chairperson of the IRB may be reached at (973) 275-2974.

This project has also been reviewed and approved by the Research and Review Committee of the Association of Physician Assistant Programs.

Thank you for your willingness to participate.

Sincerely,

Gary J. Bouchard
Doctoral Candidate, Seton Hall University

(on Seton Hall University Letterhead)

Informed Consent Form: The Effect of Problem-based Learning on Performance on the Physician Assistant National Certifying Examination

Researcher/Affiliation: Gary J. Bouchard, Doctoral Program in Higher Education Administration, Department of Educational Leadership, Management and Policy, Seton Hall University.

Purpose: Program directors of all accredited PA programs nationwide are being asked to participate 1) to assess the types of problem-based learning occurring in Physician Assistant programs nationwide and 2) to determine the effect of PBL activities on average scores on the PA National Certifying examination.

Procedure: Completion of a survey that should take no more than thirty minutes. The matrix survey which follows ("Problem-based Learning in PA Education") will ask you to identify which of the eleven choices provided best represents your program's predominant teaching modality in several subject areas. For example, if your Human Anatomy instruction is best characterized by formal lectures that include some practical or clinical information, your best choice would be line 2 of the matrix. If formal lectures in human anatomy are followed by practical laboratory experience, your best choice would be line 3 of the matrix. A few brief questions concerning the demographic makeup of your program follow the matrix survey.

Voluntary nature: Your participation is voluntary and may be discontinued at any time.

Anonymity: Survey results will be sent in tabular form to the NCCPA, and average PANCE scores will be added to your program data. To maintain anonymity, the NCCPA will be asked to replace the name of your program with a numerical identifier when providing average PANCE scores.

Storage of data: Data will be stored in a locked cabinet in the offices of the investigator.

Confidentiality: All subsequent access to and analysis of data will be performed by or under the direct supervision of the investigator.

Risks: There are no risks involved in participation

Benefits: There are no benefits involved in participation

Contact information: Direct all inquiries to Gary J. Bouchard at bouchaga@shu.edu or by regular mail through the Ph.D. Program in Higher Education Administration, Department of Educational Leadership, Management and Policy, College of Education and Human Services, Seton Hall University, 400 South Orange Avenue, South Orange, New Jersey 07079.

(over)

There are no audio or video tape recordings involved.

Subjects will be given a copy of their signed and dated consent form.

This project has been reviewed and approved by the Seton Hall University Institutional Review Board for Human Subjects Research. The IRB believes that the research procedures adequately safeguard the subject's privacy, welfare, civil liberties, and rights. The Chairperson of the IRB may be reached at (973) 275-2974.

I have read the material above, and any questions I asked have been answered to my satisfaction. I agree to participate in this activity, realizing that I may withdraw without prejudice at any time.

________________________________ ________________

Name Date

____

Title

____

Program

INSTRUCTIONS:

1. Please take a moment to familiarize yourself with the survey matrix.

- Across the top are listed curricular areas common to all PA programs.

- Down the left side are listed eleven types of instructional methods. You will note that the eleven types of instructional methods vary along a continuum of problem-based activities, from no PBL (traditional lectures) to nothing but PBL (real-world tasks as the basis for learning). Further descriptions of the 11 categories and graphic depictions of the emphasis on rules (Rul) and examples (Eg) are also provided (Figure 1).

2. Identify with an "x" the one instructional modality used most typically in each subject area.

3. Complete Page 3 regarding the demographics of your program.

4. Return the survey and the Informed Consent form to the investigator in the envelope provided.

	Terminology	Description	Example
1. Rul (Th)	Theoretical learning.	Information provided about the theory.	Traditional lecture. Standard textbook.
2. Rul (PT)	Problem-orientated learning.	Practical information provided.	Lecture with practical information. Protocols or guidelines.
3. Rul → Eg	Problem-assisted learning.	Information provided with the opportunity to apply it to practical examples.	Lecture followed by practical or clinical experience. Book with problems or experiences included.
4. Eg	Problem-solving learning.	Problem-solving related to specific examples.	Case discussions and some activities in practical classes.
5. Rul → Eg → Rul	Problem-focused learning.	Information is provided followed by a problem. The principles of the subject are then learned.	Introductory or foundation courses or lecture. Information in study guide.
6. Rul → Eg Eg → Rul	Problem-based mixed approach	A combination of problem-based and information-based learning.	Students have the option of an information orientated or problem-based approach.
7. Eg → Rul	Problem-initiated learning.	The problem is used as a trigger at the beginning of learning.	Patient management problems are used to interest the student in a topic.
8. Eg → Rul (Sp)	Problem-centred learning.	A study of the problem introduces the student to the principles and rules specific to the problem.	A text provides a series of problems followed by the information necessary to tackle the problems.
9. Eg → Rul (Sp)	Problem-centred discovery learning.	Following the presentation of the problem students have the opportunity to derive the principles and rules.	Students derive the principles from the literature or from work undertaken.
10. Eg → Rul (G)	Problem-based learning.	The development of the principles includes the generalisation stage of learning.	The investigation of patients with thyrotoxicosis is extended to a more general understanding of thyroid function tests.
11. Eg (T) → Rul	Task-based learning.	The problem is the real world.	A set of tasks undertaken by a healthcare professional are the basis for the 'problem' presented to the student.

Figure 1. Problem-based learning: a continuum.

from Harden RM and Davis MH. The continuum of problem-based learning. *Medical Teacher*, July 1998.

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DIRECTIONS: For each of the curricular components listed below, identify with an X the ONE instructional modality used most typically in its delivery to students.

	Human Anatomy	Physiology	Pathophysiology	Pharmacology	Health Promotion/Disease Prevention	Patient Education/Counseling	Human Development	Human Sexuality	Death and Dying	Multicultural Issues	Legal Issues	Professional Practice Issues
1. Theoretical learning: traditional lecture												
2. Problem-oriented learning: lectures including practical information												
3. Problem-assisted learning: lectures followed by planned practical or clinical experiences												
4. Problem-solving learning: discussion of specific cases not generalized to other subjects/disciplines												
5. Problem-focused learning: foundational lecture, problem solving, then concluding lecture/discussion												
6. Problem-based mixed approach: student's choice to begin with problem or lecture												
7. Problem-initiated learning: problems trigger student interest & introduce formal lectures												
8. Problem-centered learning: Problems are central and lead to a formal lecture/presentation												
9. Problem-centered discovery learning: problems are central, and lead to student-driven study												
10. Problem-based learning: problem solving is central to learning & generalized across disciplines												
11. Task-based learning: real-world tasks are the basis for learning												

continued →

DIRECTIONS: continued from reverse

	Medical Interviewing	Physical Diagnosis	Diagnostic Laboratory Testing	Technical Procedures/Instrumentation	Health Policy	Psychiatry	Internal Medicine	Primary Care Medicine	Surgery	Pediatrics	Obstetrics and Gynecology	Emergency Medicine	Geriatrics
1. Theoretical learning: traditional lecture													
2. Problem-oriented learning: lectures including practical information													
3. Problem-assisted learning: lectures followed by planned practical or clinical experiences													
4. Problem-solving learning: discussion of specific cases not generalized to other subjects/disciplines													
5. Problem-focused learning: foundational lecture, problem solving, then concluding lecture/discussion													
6. Problem-based mixed approach: student's choice to begin with problem or lecture													
7. Problem-initiated learning: problems trigger student interest & introduce formal lectures													
8. Problem-centered learning: Problems are central and lead to a formal lecture/presentation													
9. Problem-centered discovery learning: problems are central, and lead to student-driven study													
10. Problem-based learning: problem solving is central to learning & generalized across disciplines													
11. Task-based learning: real-world tasks are the basis for learning													

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What credential does your program offer at completion (certificate, associates degree, bachelors degree, masters degree, other)?

In what year did your program accept its first didactic-phase students?

To which consortium of APAP does your program belong?

What is the mean age of your didactic phase student body?

What is the gender breakdown (by percent) of your didactic-phase student body?

What is the racial/ ethnic breakdown (by percent) of your didactic-phase student body?