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Effective Elective? Elective Courses' Impact on Student Performance during Associated Advanced Pharmacy Practice Experiences

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Abstract:

Experiential education programs at colleges of pharmacy are guided by standards set forth by the Accreditation Council for Pharmacy Education (ACPE.) Exactly how these standards are met, however, is often determined by the individual college of pharmacy. This includes deciding how students are selected and placed on their fourth-year rotations, referred to as Advanced Pharmacy Practices Experiences, or "APPEs." While it may seem that students who have taken elective courses focused on specialized topics, such as pediatrics or geriatrics, will perform better on related APPEs, this thought remains largely unfounded. Using four years of student data at the University of Kentucky College of Pharmacy, bivariate statistics, independent samples t-tests, and descriptive statistics were utilized to compare student performance on APPEs between students who had taken specialized electives and those who had not.

Summary:

The objective of this study was to determine if elective pharmacy didactic courses impact student performance on related Advanced Pharmacy Practice Experiences.

Data from 2014-2015 through 2018-2019 was analyzed using descriptive statistics and independent samples two-tailed t-tests. Using APPE scores (1-100) and elective status (yes/no), student performance on specialized APPEs in the areas of pediatrics, emergency medicine, critical care, and geriatrics were analyzed.

There was no statistically significant difference in student performance on specialized APPEs in the areas of critical care, pediatrics, and geriatrics. Interestingly, completion of the emergency medicine elective resulted in statistically significant lower scores on associated APPEs.

This study found no difference in student performance between cohorts who completed didactic pharmacy electives and those who did not on associated specialty APPEs. Elective course completion should not preclude or exclude students from taking specialized APPEs. Furthermore,

elective course goals and outcomes must be continually assessed to ensure students are prepared to pursue careers in areas of specialty. Further research is needed to fully understand the impacts of didactic pharmacy elective courses on corresponding APPEs.

Problem Statement:

The effect of elective didactic (i.e. lecture-based) pharmacy courses on related Advanced Practice Pharmacy Experiences (APPE) remains a subject of debate. Currently, there is limited data regarding this topic. While Irons and colleagues found that ambulatory care final APPE grades were higher among those who had taken associated electives compared to those who had not, Bio et.al. found no significant difference in self-initiated interventions on APPEs based on previous specialty elective course completion.[1,2] Wanat and colleagues recently found no difference in APPE performance among students who took a didactic elective course during their Professional Year 1 or Professional Year 2 (P1/P2) year versus those who did not.[3] This study was completed at a single institution and appears to be the only one of its kind. This limited evidence leaves educators and students alike wondering what impact, if any, taking a specialty didactic elective has on related specialty APPE performance. The importance of this information is underscored by increasing pressure(s) related to success during APPEs and the impact of performance on securing residency training opportunities.

Previous work by Santee and colleagues described the variety and quantity of didactic electives at pharmacy schools across the US.[4] Didactic electives allow students to explore career interests and to become exposed to topics that may not be fully appreciated in required didactic courses. As such, these courses may impact what APPEs students select and, subsequently, influence career choices. Due to scheduling conflicts, dual-degree courses, or any other host of reasons, some students may not choose or be able to complete didactic pharmacy elective courses. While those who do not complete

the elective course have not received didactic teaching in a specialized or specific area, students still have the opportunity to explore these areas in their final year of training through elective APPEs.

APPE electives may impact students' postgraduate plans by introducing them to pharmacy career options and/or preparing them for residency. Medina and colleagues found that 75% of participants that took an academic-administrative APPE pursued a faculty position and retained their knowledge from the experience over time.[5] Furthermore, residency program directors examine students' APPE performance and elective types when evaluating residency candidates. In an online survey of 1,208 residency program directors, Clarke and colleagues found that APPE structure and elective type were influential factors when directors were determining which candidates would be extended interviews.[6]

Since APPE courses have the potential to impact a student's future career plans, determining how to create an equitable environment for students to elect into these courses should be considered. While it seems that students who have taken specialty elective courses will be more prepared to excel in associated specialty APPEs and thus should have "first pick" at selecting these opportunities, this thought remains unfounded. Alternatively, some may disagree with a random lottery that relies on student preference and chance to determine who gets to complete these experiences. This study will seek in part to determine the potential effects of elective courses on student performance in associated APPE experiences. Thus, potentially providing some insight on their utility in determining APPE allocation.

Research Question:

The primary objective of this study was to assess the impact, if any, that didactic elective courses had on student performance on associated APPEs. It is hypothesized that there will be no significant difference in student performance on associated APPEs based on elective history, as there is no research to date supporting a relationship. External variables such as the APPE setting (academic

medical center vs. non) and baseline cumulative GPA may also have an impact on student performance. In a recent study, Heldenbrand and colleagues found that pharmacy GPA positively correlated with mean APPE scores.[7] There is limited evidence to suggest that the setting of the APPE has an impact on student performance, however. Based on this, a secondary analysis of APPE setting will be conducted. It is hypothesized that there will not be a significant difference in student performance based on the setting of the APPE site in conjunction with elective history.

Literature Review:

It is important to understand the background and curricular components of pharmacy education in the United States in order to grasp today's issues in this arena. Pharmacy education formally began in 1821 when the Philadelphia College of Pharmacy initiated training of student pharmacists. By the 1940s, the American Council of Education was promoting the adoption of uniform curriculum to establish the Bachelor of Science in Pharmacy (B.S.Pharm.), a five-year degree (at least one year of undergraduate study followed by four years of professional coursework.) Eventually becoming a Doctor of Pharmacy (Pharm.D.) degree in the 1990s, this would not be the only major change that pharmacy education would see. While pharmacy had always been heavily rooted in chemistry, a clinical focus emerged in the 1970s, transferring the emphasis from medicine to patient in the field. In order to accomplish this change, the profession instituted formal patient care as a curricular component in all colleges of pharmacy.

For a majority of the profession's history, student pharmacists were required to complete experiential learning in order to sit for licensure. This learning was to take place under a "preceptor", a title given to licensed pharmacists by state boards of pharmacy which allows for teaching of students. These hours typically totaled approximately 1 year in time and could be completed during the summers between enrollment and immediately proceeding graduation. Eventually, experiential education would become formalized and owned by colleges of pharmacy rather than boards of

pharmacy in an attempt to standardize the experiences that students were encountering as well as ensure that all students were exposed to a variety of experiences. These "experiences" were given the titles of IPPEs – Introductory Pharmacy Practice Experiences, and APPEs – Advanced Pharmacy Practice Experiences. Informally, these experiences are referred to as "rotations", similar to what other medical professions term their experiential education. Typically, IPPEs take place in the student's first years of pharmacy school while APPEs are reserved for the last year of training in order to prepare the student to transition into practice. As the colleges began to own this piece of pharmacy education, experiential learning would eventually have standards set by accrediting bodies. While the original accrediting body for colleges of pharmacy was the American Council on Education, the Accreditation Council for Pharmacy Education (ACPE) was founded in 1932 to oversee the accreditation of all U.S. pharmacy education programs. ACPE is recognized by the US Department of Education for the accreditation and preaccreditation of professional degree programs leading to the degree of Doctor of Pharmacy in the United States. The most recent standards released by ACPE became effective on July 1, 2016 and are comprised of 25 standards (described in table 1 below.)

Table 1: Description of the ACPE Accreditation Standards (Accreditation Council for Pharmacy Education, 2016.)

Standard	Description
Section I: Educational outcomes	
1.	Foundational knowledge
2.	Essentials for Practice and Care
3.	Approach to Practice and Care
4.	Personal and Professional Development
Section II: Structure and Process to Promote Achievement of Educational Outcomes	
5.	Eligibility and Reporting Requirements
6.	College or School Vision, Mission, and Goals
7.	Strategic Plan
8.	Organization and Governance
9.	Organizational Culture
10.	Curriculum Design, Delivery, and Oversight
11.	Interprofessional Education (IPE)
12.	Pre-Advanced Pharmacy Practice Experiences (Pre-APPE) Curriculum
13.	Advanced Pharmacy Practice Experience (APPE) Curriculum
14.	Student Services
15.	Academic Environment
16.	Admissions
17.	Progression
18.	Faculty and Staff – Quantitative Factors
19.	Faculty and Staff – Qualitative Factors
20.	Preceptors
21.	Physical Facilities and Educational Resources
22.	Practice Facilities
23.	Financial Resources
Section III: Assessment of Standards and Key Elements	
24.	Assessment Elements for Section I: Educational Outcomes
25.	Assessment Elements for Section II: Structure and Process

Standard 10 of the ACPE Accreditation Standards relates to curriculum design, delivery, and oversight; this includes the delivery of both required and elective courses. While required coursework often relates to the most common practice settings, elective courses tend to cover

specialized practice settings that pharmacists delve into. Furthermore, required coursework is clearly defined by the standards; electives, on the other hand, are not. ACPE requires that colleges of pharmacy offer elective courses that ensure students have the opportunity to learn about career options, develop personal interests, and achieve curricular outcomes. However, ACPE does not define the number and types of elective courses required within a degree program, leaving these decisions to individual colleges and schools of pharmacy. A survey of all US colleges of pharmacy in 2011 revealed the variety of elective courses offered. These courses ranged from the common, such as pediatrics, geriatrics, and toxicology, to the uncommon, such as palliative care, nutrition, and veterinary medicine. This survey also revealed the average number of credit hours required by colleges of pharmacy for elective lecture-based courses was 7 (range 2 to 18). It is clear that elective structure varies by each individual institution.

Standard 13 of the ACPE Accreditation Standards defines criteria for APPE curriculum. Included in this standard are the four required APPEs that colleges of pharmacy must offer: community pharmacy, ambulatory patient care, hospital/health system pharmacy, and inpatient general medicine patient care. These four experiences, however, can only cover so many hours of the 1440 experiential hours that student pharmacists must complete on APPEs as mandated by ACPE. In order to accommodate for this, elective APPEs are offered which allow student pharmacists to complete experiential hours while also exploring diverse career interests. Elective APPEs often relate to specialty types of pharmacy and are dependent upon the institutions and health systems' availability. Examples of elective APPEs include rotations in pediatrics, geriatrics, emergency medicine, management, and more. The only guidance that ACPE offers for electives is the following: "programs are encouraged to develop an array of elective opportunities and, to the extent possible, allow students to select elective experiences that match their career interests." Beyond this, there are no recommendations for determining how to execute this mission.

Currently, there is limited literature supporting the correlation between didactic elective courses and related APPEs. While some may believe that taking a specific didactic elective would improve student performance on associated APPE, this claim has remained unfounded. While ACPE sets standards for rotations and elective courses, there is little guidance on the development or execution of these aspects of pharmacy curricula. Without proper guidance and due to a lack of literature pertaining to this topic, colleges of pharmacy and preceptors may enact prohibitive policies that are not supported by data and ultimately prevent student pharmacists from pursuing careers in specialty fields.

Data Sources:

This capstone involved University of Kentucky College of Pharmacy (UK COP) students from the classes of 2015-2019. APPE information, including type and site location, was collected from the experiential learning management software system utilized by the college (Core Educational Management Learning Software (Core ELMS)). Data from 2012-2019 was collected from university records to assess elective completion for the sample population. University records also provided student GPAs and unique student IDs to maintain confidentiality.

Methods:

This retrospective study conducted at the University of Kentucky College of Pharmacy (UK COP) utilized data from the graduating classes of 2015-2019. During the study period, the college employed a 4.0 grading scale for didactic coursework. APPEs use a pass/fail grading scale tied to a numeric score (1-100) assigned by preceptors on the final summative evaluation of each six-week rotation. Students must obtain a final score greater than or equal to 70 to pass. At this institution, elective courses are offered mainly in the second and third professional years, with most courses requiring that students are in their third professional year.

The inclusion criteria for this study encompassed UK COP students who completed an APPE in a specialty area from the school years 2014-2019. APPEs that were included in the assessment were those that focused on patient populations that coincided with specialty electives offered by the college (pediatrics, geriatrics, emergency medicine, and critical care.) APPE information, including type and site location, was collected from the experiential learning management software system utilized by the college (Core Educational Management Learning Software (Core ELMS)). Qualifying APPEs for analysis were selected and agreed upon by two independent reviewers.

Elective didactic courses included in the analysis were geriatrics, pediatrics, emergency medicine, and critical care. These courses are offered by UK COP and if elected are typically completed in the student's third year of pharmacy school (immediately preceding APPEs). These courses have been offered for 5 or more years at this institution, establishing consistent data and pedagogic practices. Data from 2012-2019 was collected from university records to assess elective completion for the sample population. University records also provided student GPAs and unique student IDs to maintain confidentiality.

Baseline characteristics collected included APPEs by specialty area, electives completed, GPA, and APPE location (e.g., academic health center vs community hospital). The primary outcome was final APPE scores as submitted by preceptors. A p-value $< .05$ was considered significant for all statistical analyses. One-way ANOVA and independent samples t-tests were used as appropriate to test for significant differences between groups.

Data from CORE ELMS and university records were merged into a single Excel file and imported into IBM SPSS Statistics version 25. Independent samples t-tests were completed within each APPE area to test for significant differences between elective status for GPA and student performance on APPEs as defined by numerical score. If students took more than one APPE in a particular area, the average of all their scores in that area were used in place of the individual scores.

A further analysis was conducted to examine if this relationship was different within different sites (academic medical center vs. not). In this analysis, the data was filtered to only academic medical centers and tested for significant differences between elective status and APPE performance utilizing independent samples t-tests. This test was then repeated after filtering the data to only look at non-academic medical centers. For this analysis, an academic medical center was defined as a university-owned hospital. For this secondary analysis, the student's highest APPE score was used in order to accurately assess the impact of APPE setting. This study was conducted under the College's umbrella IRB exemption for curricular data related to assessment of the PharmD program.

Results:

In the five years of data reviewed, 91 students had completed APPEs in emergency medicine, 95 in geriatrics, 64 in pediatrics, and 231 in critical care. There was no statistically significant difference in average GPA across all 5 years of student data. The numbers of students who completed specialty APPEs as well as elective completion are displayed in Table 2 and all related statistical data is reported in Table 3.

Table 2. Population Characteristics in a Study to Assess the Impact of Didactic Pharmacy Elective Courses

	Elective Completed	Elective Not Completed	APPE at Academic Medical Center
APPE Area			
Emergency Medicine (n=91)	60	31	83
Geriatrics (n=95)	43	52	0
Pediatrics (n=64)	29	35	50
Critical Care (n=231)	83	148	153

Table 3. Comparison of Student Performance on APPEs and GPA using Didactic Elective Completion

	APPE Score			GPA		
	APPE Percent Score Elective	**APPE Percent Score No Elective**	***p* value**	**With Elective**	**Without Elective**	***p* value**
APPE Area						
Emergency Medicine	88.13	90.96	.03	3.50	3.39	.002
Geriatrics	93.34	95.19	.09	3.43	3.40	.58
Pediatrics	88.74	88.76	.99	3.45	3.40	.35
Critical Care	89.94	89.32	.45	3.49	3.38	.002

For students completing a critical care APPE, GPA was significantly higher among those who had completed the corresponding elective (p=.002) but completion demonstrated no statistically significant effect on APPE scores. For students completing a pediatric APPE, neither GPA nor APPE performance was statistically different between elective completion groups. Among students completing a geriatric APPE there was no significant difference in GPA or APPE performance in terms of elective completion. For those who completed an emergency medicine APPE, students who completed the corresponding elective had a statistically significantly higher GPA (p=.002) but course completion was associated with a statistically significant lower APPE score (p=.03).

In terms of APPE location, there was no significant difference in student performance between those who took the associated elective and those who did not in either the academic or non-academic health systems cohorts for both critical care and pediatrics. For students completing APPEs in emergency medicine at academic medical centers, there was not a significant difference in APPE scores in the academic medical center cohort. Among those students completing emergency medicine APPEs at a non-academic medical center, the small sample size (n=8) precluded statistical testing due to power limitations. Statistical analysis based on geriatric APPE setting was not completed as all these experiences occur in non-academic medical center settings.

Discussion:

We sought to evaluate the effect of didactic (i.e. lecture-based) elective course completion on student performance on associated APPEs. We identified no relationship between completion of a specific elective and associated APPE performance on corresponding experiences in geriatrics, pediatrics, and critical care. These findings may impact both elective curricular design and experiential education policy. For example, the lack of correlation could be due to a mismatch between the level of difficulty in these courses. It is possible that the didactic elective courses may have increased rigor while associated APPEs have relaxed expectations or vice versa, leading to similar grades for all students regardless of elective completion. Another reason for a lack of correlation may be that elective didactic courses patient cases differ significantly compared to actual patients. It is often difficult to construct cases and patient presentations that mimic real-world practice perfectly, leading to gaps in knowledge that students do not realize until beginning APPEs. These gaps could lead to similar scores on APPE regardless of elective completion. It is also possible that APPE stress load leads to similarities in student performance. Whether a student has completed the associated didactic elective or not, APPEs present significant stress during a time when students are preparing for postgraduate programs, studying for licensure, and more. This stress does not just impact those with elective completion or those without, but rather has the potential to impact every student. This burden could be a factor that leads to similar scores between all students. Another hypothesis why there was no correlation found is the nuances presented by specific health systems. It is possible that some health systems use of specific guidelines, protocols, and other site-specific policies impact students and their performance, regardless of what they did or did not learn in an associated elective.

Interestingly, students completing the emergency medicine elective were more likely to have lower scores on associated APPEs, despite having a statistically significant higher GPA. This unexpected finding may be explained by several factors. First, the emergency medicine elective is

taught by emergency medicine preceptors where the majority of the rotations occurred. These preceptors may have had higher expectations for students who they recognized from their class, introducing grading inconsistencies for these students. Other explanations may be a mismatch of difficulty between didactic course and experiential course, as well as the patient cases presented in courses, both described previously. Lastly, it is possible that this didactic elective may simply require more contact time in terms of credit hours. This finding highlights the need for all didactic courses, whether elective or required, to have established standards for reviewing course goals and outcomes. It is integral for colleges to map various courses and topics to student performance in order to perform quality assurance.

The findings of this study suggest that electives alone may not improve student performance on associated APPEs. In order to corroborate this finding, analysis of student GPA and APPE setting was also completed. GPA was statistically different only among those who had completed either the critical care or emergency medicine elective as compared to those without. This difference in GPA did not translate to a difference in APPE performance in those completing critical care APPEs, however. Despite a statistically significantly higher GPA, emergency medicine APPE performance was significantly lower among students who had completed the associated didactic elective. Overall, GPAs were similar between groups and even when statistically different did not account for a difference in APPE performance for 3 of 4 specialty areas. The setting of the APPE (academic medical center vs. non), also demonstrated no statistically significant difference in terms of APPE performance. While academic medical centers are often anecdotally regarded as being more rigorous, it is likely that the use of a standardized student assessment across all APPEs prevented the setting of the APPE from significantly impacting student score. These secondary findings support the notion that elective completion does not impact student performance on associated APPEs.

Didactic elective courses have the potential to expose students to new knowledge and patient populations while preparing them for specialty careers. Based on the findings of this study, however, elective didactic pharmacy courses and their impacts on student performance must be carefully considered when predicting student performance on associated APPEs. As elective completion did not result in a statistically significant higher APPE score in any of our cohorts, experiential education programs at colleges of pharmacy should only cautiously use elective status as a pre-requisite for specialty elective APPEs. There has yet to be consistent data that reveals utility of didactic elective completion as use for effective APPE placement. Additionally, students should not assume that electing into a didactic elective will translate into better performance on corresponding APPEs.

It is important to note the limitations of this study. Data were drawn from a single institution thus impacting external validity. Furthermore, the time between completion of electives and the associated APPE was not considered. While didactic electives are mostly offered to students in the third professional year, there are some students who elect to take these courses in the second professional year. It is possible that students taking electives earlier would have a time lapse that could result in lower performance on associated APPEs. It is also important to note that despite these courses being offered for 5 or more years at our institution, changes in course structure, topics, instructors, and more could have introduced confounders. The evaluation of students on APPEs at our college is completed through a standardized form. While the form is the same for all preceptors, it is possible that subjective scales and criteria held by preceptors impacted final APPE scores.

Conclusion and Recommendations:

There was no difference in student performance on APPEs in the areas of critical care, geriatrics, and pediatrics among students who had completed an associated didactic elective course as compared to those who had not. Furthermore, students who completed an elective in emergency medicine had lower scores on emergency medicine APPEs. Due to the importance that elective

APPEs possess, it is vital that colleges of pharmacy prepare students to excel on these types of experiences as well as create an equitable environment for student placement into elective APPEs. Future research related to didactic elective courses and their impact on student performance may be warranted. Areas such as student and preceptor perceptions regarding preparedness and confidence after didactic course completion related to APPEs may be explored.

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