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Identifying predictors of Pharmacy Licence Examination using grade point average

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Abstract

Background: Passing the Pharmacy Licence Examination (PLE) is a goal of students and faculty. Predictors of PLE would help attain this goal.

Aims: To identify predictors of PLE using grade point averages (GPAs).

Methods: Student records including course GPAs, admissions route, specialty track, gender and PLE scores consisting of multiple choice questions (MCQ) and objective structured pharmacy examination (OSPE) were examined. Associations between student data and PLE scores were determined using linear regression analyses at the significance level of 0.05.

Results: Significant relations were found between MCQ and pharmacotherapy, pharmaceutical technology and integration of pharmacy professions (adjusted R^2=0.573), and between OSPE and pharmacy practices II (adjusted R^2=0.085). The association of admissions route and specialty track with OSPE was slight.

Conclusion: This study identified three course sub-areas: pharmacotherapy, pharmaceutical technology and integration of pharmacy professions as strong predictors of high MCQ scores suggesting that high GPAs improved high MCQ scores.

Keywords: *Grade Point Average, Licence Examination, Pharmacy Licence, Predictors*

Introduction

Introduction of pharmaceutical care has extended the pharmacy professional role from product-centred to patient-centred practices (Hepler & Strand, 1990). In the current health system, the major roles in medicine product and patient care require pharmacists with higher professional capabilities to meet the complex needs of patients (Frenk *et al*., 2010; Murdan *et al*., 2015). Responding to such requirements, pharmacy education has shifted from traditional to competency-based curricula (Malone *et al*., 2015; Nash *et al*., 2015). Likewise, the Pharmacy Licence Examination (PLE) uses the competency-based approach measuring professional capabilities of pharmacist candidates (Newton *et al*., 2008). Passing the PLE, certifying a minimum competence requirement of pharmacists, is necessary for patients and the goal of not only students but also faculty. Students need the pharmacy licence to perform their professional jobs while faculties require the PLE results to develop curricula content, teaching and learning.

In general, many institutions regulate the pharmacy programme and PLE (ACPE, 2016; NABP, 2017). For example, The Pharmacy Council of Thailand has several responsibilities for pharmacy profession, such as curricular approval, degree approval and pharmacy licence permission (PCTA, 1994). The PLE is meaningful and important in that faculties with low pass rate would face difficulty in degree approval (PCTR, 2010). In addition, the PLE pass rates are a measure of academic success, ranking pharmacy programmes of faculties (Bowers *et al*., 2014). Passing the PLE requires information enabling preparedness. Academic predictors of the PLE may be one source helping students and faculties to reach their goals.

Grade Point Average (GPA) is an academic term commonly describing academic achievement or performance of school subjects (Baker & Nemec, 2014). Several relationships between test scores and subject GPAs or between subject GPAs are evident. Students with high matriculation scores tend to perform well in the first year of pharmacy programmes (Dambisya & Modipa, 2004). Knowledge of basic sciences, such as organic chemistry, biology, physics and mathematics has demonstrated a positive influence on clinical academic performance (Crow *et al*., 2005). The Pharmacy Curriculum Outcomes Assessment (PCOA) was developed to evaluate the progression of student competencies while studying in a curriculum (Scott *et al*., 2010). GPAs of first year students, relating to PCOA examinations of second year students, has been reported (Giuliano *et al*., 2016). Effects of cumulative GPAs of

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years 1 - 3 pharmacy students on PCOA are found (Gillette *et al*., 2017), while relations of PCOA and North America Pharmacist Licensure Examination (NAPLEX) scores are revealed (Garavalia *et al*., 2017; Hein *et al*., 2017). The relationship between a pharmacy GPA of Pharm.D. students and the pre-NAPLEX scores has been studied (Chisholm-Burns *et al*., 2014).

In the admissions process, cognitive tests and non-cognitive tools are used to recruit students (Frankel *et al*., 2014). Relations between pre-admission multiple mini-interviews, a non-cognitive tool, and GPAs of years 1 - 3 pharmacy students have been found (Cowart *et al*., 2016). Specialty tracks offered by curricula could lead to differences in student performance (Islam *et al*., 2016). Regarding gender, female students seemed to achieve higher GPAs than male students (Hall *et al*., 2015). Females were better performers in self-evaluation skills than males in both first and final years (Sharif *et al*., 2007). In contrast, a study reported that males had higher scores of PCOA than females (McDonough *et al*., 2017). These results suggested gender effects on academic achievement depending on type of test.

Although overall GPAs of curricula were found to associate with PLE, further investigation on associations between specific course GPAs on PLE scores is necessary. In addition to cognitive factors, non-cognitive factors could relate to the PLE. As a result, the aim of this study was to identify predictors of PLE using course GPAs, admissions route, specialty track and gender as independent variables.

Methods

Study Design

This cross-sectional study examined academic records of a pharmacy student class after their graduation from a six-year pharmacy programme of a university in Thailand. The study was approved from the Ethics in Human Subject Research by Institutional Review Board (ME 6593 (9).15.1, November 16, 2017). De-identified data from the faculty included PLE scores, course GPAs, admissions route, specialty track and gender.

Pharmacy Licence Examination (PLE)

After completing a pharmacy curriculum, students could take the PLE for a pharmacist licence at the first or second time in April or August, respectively. The PLE consisted of two independent parts: multiple choice questions (MCQ) and objective structured pharmacy examination (OSPE) requiring a minimum of 60 % and 80 % for passing, respectively. In May, the first PLE scores would be announced on the Pharmacy Council of Thailand website and be provided to the faculties of examinees, so these first scores were analysed in this study.

Course Areas/Sub-areas and Specialty Track

The Pharmacy Curriculum requirement comprised a minimum of 231 credits consisting of six course areas with their sub-areas: 1) general education, 2) biomedical sciences with two subareas, 3) basic pharmacy professions with nine subareas, 4) specialty in pharmacy professions with two specialty tracks, 5) pharmacy practices with three subareas, and 6) electives. Fourth year students had to choose a specialty track: track 1 concentrated on medicine product and track 2 addressed patient care.

Grade Point Average (GPA)

Regarding course assessment, after completing a course or a curriculum, a measure frequently used to transcribe student academic achievement was a grading scale consisting of grade A to F with a certain point for each grade (Baker & Nemec, 2014)). A range of grading scales [points] consisted of A [4], B+ [3.5], B [3], C+ [2.5], C [2], D+ [1.5] and D [1]. GPAs determined from cumulative grades of several courses or all courses of curriculum represented the academic achievement of those courses. Only compulsory courses with grades A to D were examined.

Admissions Route

Students finishing grade 12 of high school could enter a university pharmacy programme by direct admissions using university test scores and by central admissions employing the test scores of the Association of The Council of University Presidents of Thailand. Direct admissions would select only students of schools located in 17 provinces in northern Thailand while central admissions would choose students of all schools in the country.

Data Arrangement

All courses with grades of all students were recorded in a row on a MS Excel spreadsheet. These grades were changed to points. The courses of each student were arranged in the same order according to their course areas and sub-areas. Transversely, these courses with points of each student were rearranged in a column and entered into the analysis programme. GPAs of course sub-areas were calculated.

Data Analysis

Statistical analyses were conducted using SPSS, version 17.0. Descriptive analyses were performed to present an outline of course areas/course sub-areas, their GPAs and PLE scores. Stepwise regression analyses were undertaken to identify predictors of PLE scores. Independent variables examined included GPAs of all course sub-areas, admissions route, specialty track and gender. Significance of analyses was set at p-value < 0.05.

Results

From the total of student records (n=137) 91 (66%) comprised females, 64 (47%) direct admissions and 58 (42%) specialty track 1 students. In all, 137 and 136 examinees passed MCQ and OSPE respectively, resulting in a pass rate of 99% (136/137). Of the total 100 points, the scores range were 60-84 and 78-98 for MCQ and OSPE respectively. Among five course areas, GPAs ranged from 2.87 (0.50) of basic pharmacy professions to 3.88 (0.14) of pharmacy practices. Among 17 course sub-areas, GPAs varied from 2.47 (0.71) of medicinal chemistry to 3.92 (0.13) of pharmacy practices III (Table I).

Table I: PLE Scores and GPAs by Course Areas/ Sub-areas

PLE	Scores (SD)
MCQ	74.10 (5.22)
OSPE	90.50 (3.36)

Course Areas/Sub-areas (credit number)	GPAs (SD)
General education (12)	3.80 (0.28)
English (12)	3.80 (0.28)
Biomedical sciences (48)	3.04 (0.49)
Pure sciences (23)	3.08 (0.46)
Pre-clinic sciences (25)	2.99 (0.57)
Basic pharmacy professions (80)	2.87 (0.50)
Pharmacognosy (4)	3.21 (0.67)
Pharmaceutical technology (14)	2.86 (0.50)
Medicinal chemistry (8)	2.47 (0.71)
Pharmaceutical analysis (7)	3.18 (0.57)
Pharmacotherapy (14)	2.81 (0.55)
Biopharmaceutics (10)	2.86 (0.63)
Patient communication skill (6)	2.98 (0.52)
Administrative and social sciences (11)	2.85 (0.49)
Integration of pharmacy professions (6)	3.00 (0.61)
Specialty track in pharmacy professions (26, 23)	3.39 (0.35)
Specialty track 1 (26)	3.44 (0.39)
Specialty track 2 (23)	3.35 (0.31)
Pharmacy practices (35)	3.88 (0.14)
Pharmacy practices I (1)	3.74 (0.41
Pharmacy practices II (6)	3.70 (0.40)
Pharmacy practices III (28)	3.92 (0.13)

GPA - grade point average with a maximum of 4; SD - standard deviation; PLE - Pharmacy Licence Examination; MCQ - multiple choice questions; OSPE - objective structured pharmacy examination

From linear regression analyses of PLE scores and course sub-areas, pharmacotherapy, pharmaceutical technology and integration of the pharmacy professions were significant predictors of MCQ scores explaining 57% of its variance. From another linear regression analysis, pharmacy practices II was a significant predictor of OSPE scores explaining 8% of its variance (Table II).

Table II: Regression of Course Sub-area GPAs on MCQ and OSPE Scores

Score	Model	Course Sub-areas (credit number)	Beta	*p* value	Adjusted R^2
MCQ	1	Pharmacotherapy (14)	0.724	<0.001	0.520
	2	Pharmacotherapy (14)	0.509	<0.001	0.551
		Pharmaceutical technology (14)	0.282	0.002	
	3	Pharmacotherapy (14)	0.280	0.019	0.573
		Pharmaceutical technology (14)	0.261	0.003	
		Integration of pharmacy professions (6)	0.292	0.005	
OSPE		Pharmacy practices II (6)	0.302	<0.001	0.085

MCQ - multiple choice questions; OSPE - objective structured pharmacy examination

Linear regression analyses of PLE scores and student demographics revealed that admissions route and specialty track significantly predicted MCQ scores explaining 6% of its variance while admissions route significantly predicted OSPE scores explaining 2% of its variance (Table III).

Table III: Regression of Admissions Route and Specialty Track on MCQ and OSPE Scores

Score	Model	Independent variables	Beta	*p* value	Adjusted R^2
MCQ	1	Admissions route	-0.232	0.006	0.047
	2	Admissions route	-0.222	0.009	0.067
		Specialty track	0.165	0.049	
OSPE		Specialty track	0.176	0.040	0.024

MCQ - multiple choice questions; OSPE - objective structured pharmacy examination

Discussion

This study investigated the predictive association between PLE and course sub-areas using their scores and GPAs, respectively. The findings suggested that pharmacotherapy, pharmaceutical technology and integration of pharmacy professions were strong predictors of the MCQ part. High GPAs of these course sub-areas enhance high MCQ scores. Pharmacy practices II was a weaker predictor of the OSPE part. Similarly, admissions route and specialty track were weak predictors of the MCQ and OSPE parts. This academic information may assist students and faculty preparing for the PLE.

This study provided an advancement of pharmacy education by offering specific predictors of the PLE. Compared with pharmacy GPAs, a general predictor (Allen & Diaz, 2013), course GPAs from this study were more extensive predictors. This evidence enables students to focus on significant courses and faculty to target course developments facilitating student preparedness and academic success in the PLE.

This research suggested not only specific but also stronger predictors of the PLE. Compared with predictors of the NAPLEX accounting for 40% of variance (Chisholm-Burns, 2017), predictors of this study explained more than a half of the PLE variance. Among nine course sub-areas of basic pharmacy professions, pharmacotherapy presents the strongest predictors indicating its dominance and importance to the PLE. This finding promotes students of both specialty tracks preparing pharmacotherapy competence for the PLE. Moreover, students equipped with high pharmacotherapy competence may improve the pharmacist role in patient care at the workplace (Munger *et al*., 2017).

In addition to the strongest predictors of the MCQ part, pharmacotherapy involving patient care confirmed the shift from product- to patient-approach for the pharmacy profession (Fazel *et al*., 2017). Though pharmaceutical technology was a weaker predictor, it was still essential for pharmacy professions. Clinical and pharmaceutical sciences were necessary for medication management at practical settings (Loewen *et al*., 2016). Thus, students should prepare both sciences not only for the PLE but also for their pharmacy practice (Bramley *et al.*, 2013; Pestka *et al*., 2016).

Another predictor was the course sub-area of the integration of pharmacy professions. Although it presented a slight effect on the MCQ, it was based on the integration approach involving a learning style collecting, cumulating and combining knowledge, skills and attitudes from various or previous courses (Pearson & Hubball, 2012). A specific skill at application by integrating the knowledge about pharmaceutical chemistry and therapeutic actions of medicines was evident (Sattenstall & Freeman, 2009). Frequent use of integrative abilities promotes their experience readiness to deal with advanced needs of healthcare by patients and health teams in the workplace. Using the integration approach in courses as much as possible and adding credit to them are ways to improve student learning.

Pharmacy practices II was the only predictor of the OSPE part section with a slight effect while the other pharmacy practices were not. Pharmacy practices II is a requirement for all fourth-year pharmacy students. Possible explanations may be that pharmacy practices II is the requirement for all fourth-year pharmacy students involving core professional practices at hospitals and community pharmacy settings. Pharmacy practices I concerns patients in their context that student could understand, be familiar with and communicate with them effectively. The OSPE may be irrelevant to measure such practices. Pharmacy practices III assigned by the Pharmacy Council of Thailand consisted of compulsory and choice settings. Compulsory settings included medicine factories for specialty track 1, and hospital and community pharmacy for specialty track 2 while choice settings might contain a variety of settings depending on each pharmacy faculty in the country. This variety of settings might be one limitation of the OSPE to cover all specialty skills in the OSPE.

Regarding non-cognitive variables, admissions route and specialty track showed slight associations with the PLE, similarly to a relative low relation of age to the NAPLEX (McCall *et al*., 2007). However, for faculty, direct admissions students had higher MCQ scores than central admissions students helping faculty decisions on student recruitment. For students, this finding might help them choose a specialty track basing on their interest rather than the track effect on the PLE.

This study suggested an average score of the PLE as another measure of academic success in addition to pass rate of the PLE. Only a pass rate might be inadequate to show academic success completely and clearly. Specifically, faculties with high pass rate should continuously improve student competency by increasing the average score. For the PLE, a pass rate along with an average score could provide a more complete and clear academic success of students and faculties.

Conclusion

This study identified course sub-areas as predictors of the PLE using their GPAs and scores, respectively. Strong predictors of the MCQ part included pharmacotherapy, pharmaceutical technology and integration of pharmacy professions. Increasing GPAs of these course subareas improved MCQ scores. A weak predictor of the OSPE part was pharmacy practices II. These findings are course information enabling students and faculty to specifically prepare important courses for passing the PLE.

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Conflict of Interest

The authors declare they have no conflicts of interest related to this work.

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