













RESEARCH ARTICLE

A quantitative perspective on the correlation between students' cumulative grade point average and their results in the Doctor of Pharmacy programme in Saudi Arabia

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Keywords

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Abstract

Background: The colleges of pharmacy in Saudi Arabia share a set of unified programme learning outcomes for their Doctor of Pharmacy (Pharm.D.) programmes. Based on this, a unified progress test for pharmacy students has been implemented over the past five years. The aim of this study is to correlate the students' results in the test to their cumulative grade point average (cGPA). **Methods:** The progress test is usually composed of 100 multiple choice questions, 30 of which cover basic pharmaceutical sciences and 70 cover pharmacy practice. The questions were selected from a question bank for this purpose prepared by the participating colleges. The test was administered online to all undergraduate students in the professional programmes of the participating colleges. **Results:** The attendance percentage was approximately 72% of the total number of students enrolled in 16 participating colleges. The results indicated positive correlation between the students' results in the test and their cGPA, however, there was some negative correlation, especially in the first professional levels of some programmes. **Conclusion:** The results showed an overall good and reasonable correlation mainly for professional third and fourth year students. It was difficult to draw conclusions about the strength of the test in assessing the programme learning outcomes.

Introduction

Progress tests were introduced more than 40 years ago and have been mainly implemented in medicine (Arnold & Willoughby, 1990; Van der Vlueten, 1996; Al Alwan *et al.*, 2011). This approach of assessment was eventually adopted by other medical disciplines, including pharmacy and dentistry (Begly, Monaghan & Qi, 2013; Karimi *et al.*, 2014; Bennet *et al.*, 2010; Medina, 2017). The number of pharmacy schools in the Kingdom of Saudi Arabia (KSA) has significantly increased over the last two decades. Additionally, the KSA healthcare system has also significantly expanded to match the increase in the population of the country. Therefore, there is an ever increasing demand for well-trained pharmacists equipped with deep knowledge and skills to effectively contribute to the healthcare system by providing optimum pharmaceutical care. The continuous increase in pharmacy graduates requires assessment tools capable of assessing learning outcomes and harmonising knowledge and skills taught in different institutions. Pharmacy competencies are basically constructed around three major and broad domains, which are: cognitive, psychomotor and affective skills (Sacre *et al.*, 2022). Subdomains to these three broad domains are developed by different pharmacy programmes to address foundational knowledge, essential skills for practising pharmacy, and personal and professional development of pharmacy graduates. Currently, most pharmacy programmes adopt an assessment methodology focused on using testing modalities at the end of each semester or module. This approach may promote short-term memorisation by the students rather than deep learning to retain knowledge and skills. The progress test is a comprehensive longitudinal assessment tool that can be used to measure the gain of knowledge and skills of the students throughout the curriculum (Blake *et al.*, 1996; Reberti *et al.*, 2020). Proper design and application of this test will allow monitoring of students' growth patterns in the curriculum with repeated tests in addition to comparison of cohorts (Basu *et al.*, 2004). Therefore, the progress test is one of the tools that may help in continuous assessment and revision of the pharmacy curriculum to serve this purpose. Based on the concept of this test, assessment of students based on repeated testing will be logical to make predictions about their future competence and performance by monitoring their development during the programme until graduation (Schuwirth & Van der Vleuten, 2012).

The culture of progress testing has spread widely in the colleges of pharmacy in the KSA over the past five years. This is due to a considerable effort of the Deans' Council, which is membered by all the deans of the

colleges of pharmacy and periodically chaired by one of them. In a previous report, the authors evaluated the utility of sharing a unified progress test among all the colleges of pharmacy in the KSA since all the Doctor of Pharmacy (Pharm.D.) programmes offered by these colleges share a unified set of 18 programme learning outcomes (PLOs) in their programmes (Albekairy *et al.*, 2021). Sharing a unified progress test among all the colleges of pharmacy was one of the resolutions taken by the Deans' Council, however, the participation in the test is optional for the colleges. The question items used in the unified test are collected from all the colleges participating in the test and saved in a question bank for this purpose. All of them are in the form of multiple choice questions (MCQs) with five options, where the fifth one is 'I do not know'. This option is used to minimise guessing by the students when selecting their answers. The questions used in the test are selected by a panel of content experts assigned by the Deans' Council and another assigned panel will review and verify the selected questions against the unified set of PLOs based on a blueprint prepared for this purpose.

This study will report on the unified progress test that was conducted during the 2021-2022 academic year with the aim of investigating the correlation between the students' grades in the progress test and their cumulative grade point average (cGPA) at the time when the test was administered. In addition to assessing the achievement of the students in the unified PLOs based on their grades in the progress test since each question in the test was mapped or linked to a certain PLO. Unified progress tests have been shared among several colleges of pharmacy over the past four years to assess the progress of their Pharm.D. students through their curricula. However, the results were only used to report on the achievement of students in each programme and for benchmarking purposes. This prompted the authors to expand and use the latest test data to investigate the correlation between students grades in their progress tests and their cGPA.

Methods

Study design

This study followed the same design as was used in a previous report (Albekairy *et al.*, 2021). The participating colleges in the test were identified and content experts from the faculty members of two colleges were assigned to select questions from the question bank based on the same inclusion and exclusion criteria as published in a previous report. Other content experts who were faculty members of another two colleges were assigned to

verify the selected questions regarding content, structure and mapping to the unified PLOs. The test was composed of 100 MCQs, where 30 of them cover the areas of basic pharmaceutical sciences and the remaining 70 covers the areas of pharmacy practice in both clinical and non-clinical disciplines. The test was designed to be administered online over two hours, and the target students are only the students enrolled in the professional Pharm.D. programme from professional year one (P1) to professional year four (P4). Since the study did not involve the use of human subjects or withdrawal of biological samples from any volunteers, there was no need for Institutional Review Board (IRB) approval.

Sixteen colleges participated in the test and for the purpose of reporting, the results were identified by codes (C1-C16) for anonymity. In addition, the results were treated as collective and combined results from all the participating colleges. The test was administered online during the eighth week of the second term by all colleges at the same date and time. The students were informed about the test just two days before the test since they did not have to do any prior preparation or studying for the test. The students were all also instructed and guided through email on how to access the test at the specified time. The results were collected by each college for their students and all reported their results to the College of Pharmacy at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) since the task was led by this college for analysis and interpretation of the results.

Statistical analysis

One-way analysis of variance (ANOVA) was used for determination of the level of significance in addition to descriptive statistics, whenever appropriate, for calculation of the number and percent of categorical variables and the mean and standard deviation. According to Pearson correlation coefficient, a p -value < 0.05 is to be considered significant.

Results

A total of 16 colleges offering Pharm.D. programmes in the KSA have participated in the test. Table I presents a summary of the number of students enrolled in the programme of each college and the number of students who attended the test. The total number of students who attended the test was 3,525, with an overall attendance percentage of 71.7%. The attendance percentage among colleges ranged from approximately 44% to 93%.

Table I: Participating colleges, the total number of enrolled students and the number of students who attended the progress test

College	Students Enrolled (n)	Students Attended (n)	Attendance (%)
C1	336	314	93.5%
C2	232	180	77.6%
C3	260	217	83.5%
C4	446	196	44.0%
C5	274	256	93.4%
C6	610	511	83.8%
C7	413	243	58.8%
C8	275	239	86.9%
C9	125	72	57.6%
C10	216	173	80.1%
C11	335	198	59.1%
C12	170	148	87.1%
C13	258	169	65.5%
C14	460	269	58.5%
C15	195	110	56.4%
C16	309	230	74.4%
Total	4,914	3,525	71.7%

C: College, n: number

Table II shows the average results (mean scores %) in the progress test for all students who attended the test from each college. The average results ranged between a minimum of 20.5% and a maximum of 43.4%. The average results were also calculated according to the professional year level in the programme as shown in Table III from P1 to P4 as combined mean scores from all participating colleges. The table also shows the minimum and maximum score for each professional level.

Table II: Average progress test results (mean scores %) for all students in the participating colleges

College	Mean Scores (%)*	Variance
C1	42.3	218.99
C2	20.5	287.36
C3	28.4	209.02
C4	43.4	200.99
C5	26.4	120.31
C6	26.5	140.28
C7	35.7	189.64
C8	25.7	140.15
C9	31.8	58.34
C10	26.8	130.82
C11	42.7	55.15
C12	37.8	154.13
C13	34.1	188.65
C14	37.7	199.35
C15	35.8	179.88
C16	38.6	215.66

* P -value < 0.05

Table III: Mean scores of all students in each professional level in the Pharm.D. programme (P1 – P4) as combined results from all the participating colleges

Professional Level	Mean Score (% ± SD)	Minimum Score (%)	Maximum Score (%)
P1	29.59 ± 9.02	9.6	50.3
P2	38.31 ± 11.99	4.8	64.7
P3	45.78 ± 10.87	13.4	68.8
P4	51.33 ± 16.77	5.9	78.7

P-value < 0.05; SD: standard deviation

The correlation between the progress test results and the cGPA of students was assessed based on the data obtained from 11 colleges as a representative sample from all 16 participating colleges. The correlation is presented in Table IV. In general, the data indicated a positive correlation, however, there was some negative correlation especially in the first professional levels of some programmes. Overall, the means of correlation ranged from -0.039 for P1 to 0.37 for P4.

Table IV: Correlation between grades in progress test and cGPA of students through the professional levels of the Pharm.D. programme

College	P1	P2	P3	P4
C1	0.121	0.282	0.420	0.412
C2	0.228	0.399	0.439	0.368
C3	-0.270	0.510	0.435	0.282
C6	0.064	0.129	0.263	0.407
C7	-0.237	0.388	0.498	0.345
C8	-0.055	0.265	0.232	0.237
C11	-0.036	0.117	0.177	0.378
C12	-0.057	0.216	NA	0.571
C14	-0.053	0.368	0.338	0.419
C15	-0.466	0.391	0.191	0.288
C16	0.328	0.373	0.317	0.425
Mean ±	-0.039 ±	0.313 ±	0.331 ±	0.376 ±
SD	0.227	0.122	0.114	0.090

P1, P2, P3 & P4: Professional levels 1, 2, 3 & 4

Table V presents the assessment of the Pharm.D. unified PLOs among the colleges of pharmacy based on the achievements of the students from participating colleges in their progress test. According to the Saudi National Qualification Framework (NQF), there are three domains for the PLOs, and these are: knowledge and understanding, skills and values. The data are presented in Table V in the form of range showing the lowest average achievement to the highest. For knowledge and understanding the range was between 29.1-50.7 and for skills and values, the ranges were 18.7-43.2 and 22.1-47.4, respectively. There was

significant statistical difference between the groups where p -value < 0.05.

Table V: Assessment of the unified Pharm.D. programme learning outcomes (PLOs) based on the progress test results

Domain	Number of PLOs Assessed	Range (Mean %)
Knowledge and Understanding	3	29.1 – 50.7
Skills	4	18.7 – 43.2
Values	5	22.1 – 47.7

Discussion

Due to the fact that Pharm.D. programme's graduate attributes are mainly patient-centered to provide optimum pharmaceutical care, approximately 70% of the progress test contains questions addressing areas of clinical pharmacy and pharmacy practice. In this study, 16 colleges have participated in the test with a very good attendance rate (71.7%) of the students who are enrolled in the Pharm.D. programmes of these colleges. The programmes selected in this study are those from colleges that had an attendance rate of their students for the test above 40%.

The mean scores (%) of the students in the participating colleges as shown in Table II were close to each other and there was no significant difference between them (p -value < 0.05). This indicates similarity between the programs since they are sharing a unified set of PLOs. Among the total number of PLOs of each programme, there are 18 PLOs that are unified among all Pharm.D. programs at the colleges of pharmacy in the KSA. This also indicates valid and effective mapping of the question items used in the test to these PLOs which also has been shown in other reports (Bicudo *et al.*, 2019).

Table III shows a progressive increasing percentage of the students' scores in the test while they progress through the professional years of the programme (P1 to P4). It shows that P1 students scored the lowest whilst P4 students scored the highest. This is consistent with the growth of students, maintenance of knowledge and development of skills as they progress through the professional years of the programme. The P1 students' mean scores were 29.6% ± 9.02 with a progressive increase in P2 and P3 to reach a mean score of 51.3% ± 16.8 for P4 students. This is a well-documented trend since the introduction of progress testing in the 1970's and consequently during the application of the test by different institutions, and specifically, in medical

education (Lillis *et al.*, 2014; Junior *et al.*, 2016; Hamamoto *et al.*, 2019).

Assessment of the correlation between students' results in the progress test and their cGPA has been performed based on the data of 11 colleges since the remaining colleges did not provide complete data regarding cGPA of their students. However, the number of students from these 11 colleges was considered to be a satisfactory sample size for the purpose of investigating the correlation where the total number was 2,659 students. The data presented in Table IV indicated a negative mean value for the correlation concerning P1 while the means for the subsequent levels (P2 - P4) were positive. The highest percentage of correlation was for P4 where it was about 37.6%. The results of correlation show a reasonable increment in their values as we go from lower level to higher levels in the programme (P1<<P2<P3<P4). This observation supports the expected fact that the growth and improvement of the gained knowledge and skills of the pharmacy students are highly observed during their progress in the curriculum and well correlated with their cGPA. However, the correlation level for P1 was negative and this is expected since the students are in their first year of the professional programme and their courses are mainly in the areas of basic pharmaceutical sciences without any exposure to disciplines of clinical pharmacy and practice. Therefore, their results in the progress test at this level are not indicative and it is expected that they will not correlate with their cGPAs. Positive and increasing correlation levels are clearly indicatives for P2, P3 and P4. The majority of the pharmacy colleges included in this study calculate the cGPA for their students on a scale out of five and some of them out of four. To investigate if this would create any differences in the correlation, we have converted the students' cGPAs to percentages and it showed the same results as using the absolute numbers either as out of four or five.

Several reports have investigated the correlation between the progress test and other assessments of graduates like medical residency and licensing examinations (Karay & Schaubert, 2018, Andrade *et al.*, 2020, Andrade *et al.*, 2022). In addition to showing that the progress test was a suitable tool to monitor the growth of students' knowledge during their medical training, they provided a strong evidence on the correlation between the progress test for 4th, 5th and 6th year medical students and their residency scores (Karay & Schaubert, 2018; Andrade *et al.*, 2020). Another study showed strong correlation between the grades on the progress test and the medical clerkship rotations and medical residency examinations grades (Andrade *et al.*, 2022). Their results also support that the correlation could be stronger at higher levels of the programme as shown by this investigation where the correlation was

the highest for P3 and P4 students. Although the progress test assesses a formative content and the cGPA measures a summative dimension, the correlation might be a good indicator since there is a linear rise in the students grades in the progress test towards the end of the professional programme and it has always been noticed that students with higher cGPA usually achieve higher scores in the progress test (Junior *et al.*, 2016; Albekairy *et al.*, 2021). However, the authors suggest considering investigating the correlation of the progress test results, especially for P3 and P4 pharmacy students, with their performance in the residency and the national licensing examinations after their graduation since these tests also measure a formative dimension with a similar fashion as the progress test.

The unified Pharm.D. PLOs are three under the domain of knowledge and understanding, four under skills and 11 under values constituting a total of 18 PLOs. All the PLOs under the first two domains were assessed in this test, however, only five PLOs under the values domain have been assessed. The assessment was based on the mean scores of the students on the questions aligned or mapped to these PLOs mentioned under each domain. Since the test is based on MCQs, it is difficult to assess all the PLOs under the values domain as some of them have to be assessed by other assessment methods like rubrics, case/topic discussions and practical sessions. For this domain in particular, we have used type of questions to assess some PLOs that evaluates aspects of cognitive skills, application of guidelines and competence. According to Table V, the highest scores were relatively on the questions addressing the domain of knowledge and understanding and this is consistent with the trend that we have noticed in a previous study by Albekairy and colleagues (2021). This could be due to repeating and emphasizing the basic concepts of knowledge and understanding during most of the learning activities through the professional programme. The range for this domain was higher compared to the range of scores for the skills and values domains. However, it was difficult to draw a strong conclusion based on this assessment due to the limitation of using MCQs in the test especially for the values domain where only five PLOs out of 11 have been assessed. A major strength of this study is the inter-institutional aspect of the study which included a large number of students enrolled in the professional programmes of 16 pharmacy colleges. This largely minimised the inclusion bias in the investigation. However, investment in resources and requirement of high commitment by the involved colleges to ensure high validity and reliability of the test, may constitute some limitations for this kind of studies.

Limitations

The unified Pharm.D. PLOs are three under the domain of knowledge and understanding, four under skills and 11 under values constituting a total of 18 PLOs. All the PLOs under the first two domains were assessed in this test, however, only five PLOs under the values domain have been assessed. The assessment was based on the mean scores of the students on the questions aligned or mapped to these PLOs mentioned under each domain. Since the test is based on MCQs, it is difficult to assess all the PLOs under the values domain as some of them have to be assessed by other assessment methods like rubrics, case/topic discussions and practical sessions. For this domain in particular, the authors used a specific type of questions to assess some PLOs that evaluate aspects of cognitive skills, application of guidelines and competence. According to Table V, the highest scores were relatively on the questions addressing the domain of knowledge and understanding and this is consistent with the trend noticed in a previous study by Albekairy and authors (2021). This could be due to repeating and emphasising the basic concepts of knowledge and understanding during most of the learning activities through the professional programme. The range for this domain was higher compared to the range of scores for the skills and values domains. However, it was difficult to draw a strong conclusion based on this assessment due to the limitation of using MCQs in the test especially for the values domain where only five PLOs out of 11 have been assessed. A major strength of the present study is the inter-institutional aspect of the study where it included a large number of students enrolled in the professional programmes of 16 pharmacy colleges. This has largely minimised the inclusion bias of this investigation. However, investment in resources and requirement of high commitment by the involved colleges to ensure high validity and reliability of the test, may constitute some limitations for this kind of studies.

Conclusion

The progress test has been shown to be an important tool to understand the performance evaluation process of the pharmacy students. Most of the published studies have mainly investigated the performance of medical students in progress testing along with some correlation with other performance indicators for this profession. This study is an attempt to investigate the correlation between the pharmacy students results in a unified progress test and their cGPA in the authors knowledge there are no published reports on this issue.

The results showed good and reasonable correlation especially for P3 and P4 students. However, it was difficult to draw conclusions regarding the strength of the progress test in assessing the unified PLOs of the Pharm.D. programme. Based on these results, this approach might be more practical to evaluate the correlation between pharmacy students results in the progress test, particularly P3 and P4, and their performance in residency and licensing examinations since these tests are usually taken immediately after graduation.

Conflict of interest

The authors declare no conflict of interest.

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