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ORIGINAL ARTICLE

The relationship between study skills and perceived program difficulty among pharmacy students in Nigerian Universities: A cross-lagged study

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No conflict of interest is present in the conduction or the reporting of this study

ABSTRACT

Study skills (SS) are a significant predictor of academic performance and potentially influence perceived program difficulty (PD) from the perspective of the individual student. Most studies on the associations between SS and PD have been majorly cross-sectional design. Hence, our understanding of the relatedness between both constructs over time has not been empirically tested among undergraduate students. To address these gaps, a cross-lagged path design was adopted using pseudo-longitudinal or repeated cross-sectional data randomly collected from three separate class levels representing three different timelines- parts 3 (*N*=118), 4 (*N*=115), and 5 (*N*=117) undergraduate pharmacy students from three purposively selected public universities in southwest, Nigeria. Structural equation modeling was used to test hypotheses. The analysis of variance test was used to compare the mean scores of SS and PD across class levels.
The study participants consisted of 195 (55.4%) females and 157 (44.6%) males with an average age of 22.80 years (SD=2.37). Mean scores of PD and SS were stable and/or consistent among students. PD at time 1 had a negative impact on SS at time 2, and not the other way around. PD from time 2 to 3 was weakened while SS at time 2 to 3 was strengthened. This implies that PD tends to decrease and SS tends to improve over time. The study affirms that students' perception of PD tends to influence SS and not the other way around, especially at lower class levels. In other words, an average pharmacy undergraduate student's modification of studying patterns or habits depends on PD. The study recommends the early integration of study skills courses in the undergraduate curriculum to minimize students' perceived PD. The study deepens educators' understanding of the time-dependent relationship between PD and SS, which has consequent implications for education planning for undergraduate pharmacy students.

Keywords: Study skills, perceived program difficulty, pharmacy students, cross-lagged analysis, quasi-longitudinal data, pharmacy education

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INTRODUCTION

Generally, the academic course requirement and consequent workload for attaining a pharmacy degree are arguably some of the most demanding and stressful among the science disciplines globally [Sansgiry et al, 2005; Frisk et al, 2011; Liu et al, 2021]. Generally speaking, many reasons have been adduced for the perception of difficulty encountered by undergraduate students which include academic workload, stress, financial burden, test or exam anxiety, and stressful events (Marshal et al, 2008; Choi et al, 2019). Program difficulty (PD) broadly identifies the intensity of academic expectations demanded from a student which differs from person to person as well as program requirements specific to courses (Choi et al, 2019; Erhun et al, 2022). As a response to the inherent difficulties faced by students, students deploy study skills (SS) or habits that align with the demands presented by the courses in the program. Globally, study habits are considered the most critical predictor of academic success, and unfortunately, students without an appropriate understanding of its strategies do not benefit [Odiri, 2015]. SS relates to measures taken by students to minimize the demands of academics by adapting and improving reading skills, time management, resources, test preparation, note-taking, and memorizing (Sariem et al, 2014; Xhomara, 2021). Studies have revealed that PD has positive and negative effects on students' study skills. For instance, high levels of PD have been found to stimulate or trigger better study skills in students. According to McKiernan et al. (2020), students who adopt the right study skills as a coping strategy tend to succeed in their academic pursuits.

On the other hand, the findings of Liao et al (2021) and Erhun et al (2022) revealed the prominence of negative responses from students in the form of mental health concerns anxiety, tension, depression, panic, and illness. The untoward effects of highly demanding programs on the well-being of students are of concern among educationists and curriculum developers (Choi et al, 2019; McKiernan et al. 2020). Consequently, studies (Sansgiry et al, 2005; Jegede et al, 2020; Aboagye et al, 2020; Liu et al, 2021; Erhun et al, 2022) have shown that there is a possible or implicit reciprocal relationship between both constructs (PD and SS) depending on the context. That is, PD influences students' attitudes toward adopting SS, and SS also influences students' perceptions of PD. In this vein, to the best of the authors' knowledge, studies (Sansgiry et al, 2005; Jegede et al, 2020; Aboagye et al, 2020; Liu et al, 2021; Erhun et al, 2022) involving PD and SS are predominantly cross-sectional in nature (that is, data is collected only at one point in time) with the inherent disadvantage of been incapable of predicting changes in behavior or perception over time. However, time-varying changes in perception can be addressed using a repeated cross-sectional study design known as a pseudo-longitudinal design (Yee & Niemeier, 1996; Rafferty et al, 2015; Pan, 2021). A unique attribute of this approach means that data can be collected from different samples from the same population at several points in time to evaluate possible changes at the aggregate level (Rafferty et al, 2015; Pan, 2021).

Moreover, studies specific to pharmacy students have elaborated on the role of academic program difficulty (PD) in terms of the demanding nature of the training and studying time requirements, as responsible for high dropout rates, poor academic performance, conversion to other science courses, and mental health issues [Jegede et al, 2020a; Liao et al, 2021; Erhun et al, 2022]. Generally, the study skills (SS) of the individual student play a direct role in ensuring the desired academic performance in the face of perceived program difficulty (PD) [Didarloo & Khalkhal, 2014; Aboagye et al, 2020]. This is pertinent because the utilization and adoption of appropriate study skills enhance the capacity of students to achieve academic success. Delphine et al. (2022) identified study skills as a multidimensional construct comprised of time management, note-taking, writing skills, reading, test preparation, and test-taking. Furthermore, research done by several authors- Chinn et al. (2010), Petersen et al. (2016), and Crede et al. (2008) had linked study skills to habits related to outcomes such as enhanced student learning, students dropping courses, repeat of courses and class or possible exit from school.

Although, studies have addressed the effect of study skills on academic performance [Sariem et al, 2014; Jegede et al, 2020b; Xhomara, 2021], to the best of the researcher's knowledge, no known study has empirically addressed the reciprocal causal relationship between study skills (SS) of students and perceived program difficulty (PD) over time using a cross-lagged path design from repeated cross-sectional data. This is pertinent because this study provides empirical support for the directionality of causality between SS and PD should be established. Does SS influence the perception of PD among undergraduate pharmacy students consistently over time? Or is the reverse the case, that is, is the perception of PD directly influencing students' sense of SS over time? Is the direction of hypothesized effects unidirectional or reciprocal relationship between SS and PD across the academic levels of undergraduate pharmacy students in Nigerian Universities? The outcome of these evaluations would support curriculum review and specific support for undergraduate pharmacy students across levels.

Study skills (SS)

Study skills refer to the methods, skills, and behaviors that influence the learning process or activity such that they stimulate and convert study into the desired academic performance demanded by the student [Sariem et al, 2014; Sansgiry et al, 2006]. Study skills (SS) vary from person to person and could positively or negatively impact academic performance depending on how it is presented or expressed. Zimmerman (2005), Colthorpe et al. (2019), and Mckieman et al. (2020) identified study skills as an aspect of self-learning that is based on forethought, performance, and self-reflection engaged by high-performing students. In the same vein, Sariem et al. (2014) in a study situated in Nigeria affirmed the positive associations and impact of SS on performance among pharmacy students. Generally, SS is considered the most critical predictor of academic success, and unfortunately, students without an appropriate understanding of its strategies do not benefit [Odiri, 2015]. However, studies assessing SS among students have been purely cross-sectional, thereby inherently limiting information to a single point in time [Liao et al, 2021; Didarloo & Khalkhal, 2014; Aboagye et al, 2020]. Several measures of SS among students have been developed and addressed key domains such as reading skills, time management, test preparation, note-taking, and memorizing [Sansgiry et al, 2005; Ezeala & Siyanga, 2015].

Program difficulty (PD)

Generally, program difficulty, on the other hand, explains the challenges students face during their stay in school. Education institutions, academics, and curriculum developers are faced with the fallouts of the inability of students to cope with the demands of the programs in which they have enrolled (Sansgiry et al, 2005; Stegers-Jager, 2013; McKiernan et al. 2020). These challenges are reflective of heavy academic workload, stress, test or exam anxiety, forming peer and lecturer relationships as well as stressful events such as the effects of COVID-19 [Frisk et al, 2011; Liu et al, 2021; Marshall et al, 2008; Choi et al, 2019]. According to Choi et al. (2019)

and Erhun et al. (2022), program difficulty can be described in terms of outcomes such as low grade point average, failing a course, repeating a class or reseating a failed course, and coping with the adjustments required to succeed in the program. A qualitative study by Choi et al. (2019) revealed that students' perceptions of PD had some impact on the likelihood of remaining in pharmacy school. This gives credence to the imperative for academicians to identify areas of difficulty among pharmacy students (Choi et al. 2019). In the same vein, according to Frick et al. (2011), PD is expressed by the stressful conditions (course load, time constraints, etc.) of the pharmacy program and tends to differ based on the academic level. Hence, examining the change in perception of PD over time is essential to support possible curriculum adjustments. Jegede et al. (2020) in evaluating students' perceptions of teaching and assessments in Nigerian public universities revealed apparent differences in perceptions of students across class levels. This presupposes that perceptions of PD may experience change over time as they move or progress from one class to another.

Relationship between SS and PD in Pharmacy Education

According to Choi et al. (2019), academics must identify program difficulty (PD) issues faced by students to design strategies (less stressful and student-focused attributes) that may include improving students' SS. This evaluation is pivotal to supporting and sustaining students' performance and retention in undergraduate pharmacy programs [Amie et al, 2019]. For instance, according to D'Souza and Broeseker, (2022), first-year pharmacy students tend to experience program difficulty (PD) due to increased rigor of study, course load, unfamiliar faculty environment, test anxiety, and low academic competence. Also, Jegede et al (2020), Erhun et al (2022), and Jegede et al (2024) adduced the high incidence of class repetition and subsequent withdrawal due to increased study load and difficulty encountered by students undergoing pharmacy training. Despite the availability of empirical evidence of the relatedness of PD and SS in the educational context between SS and PD on academic performance among undergraduate pharmacy students [Sariem et al, 2014; Jegede et al, 2020b; Xhomara, 2021], there is an apparent paucity of empirical research studies to empirically test and substantiate the changes over time using cross-lagged panel analysis with pseudo-longitudinal data from surveys in their final three years in pharmacy school, the causal precedence between SS and PD among students in Nigerian Universities. Therefore, the study outcomes would improve our understanding of how strongly study skills (SS) and program difficulty (PD) influence each other over time.

Objectives of the study

The main objectives of the study are:

1. To test the association between study skills and program difficulty over time
2. To test the stability of effects for study skills and program difficulty over time
3. To empirically test the direction of causal or reciprocal effects (causal dominance) between studying skills and program difficulty
4. To compare the mean difficulty of PD and SS across class levels

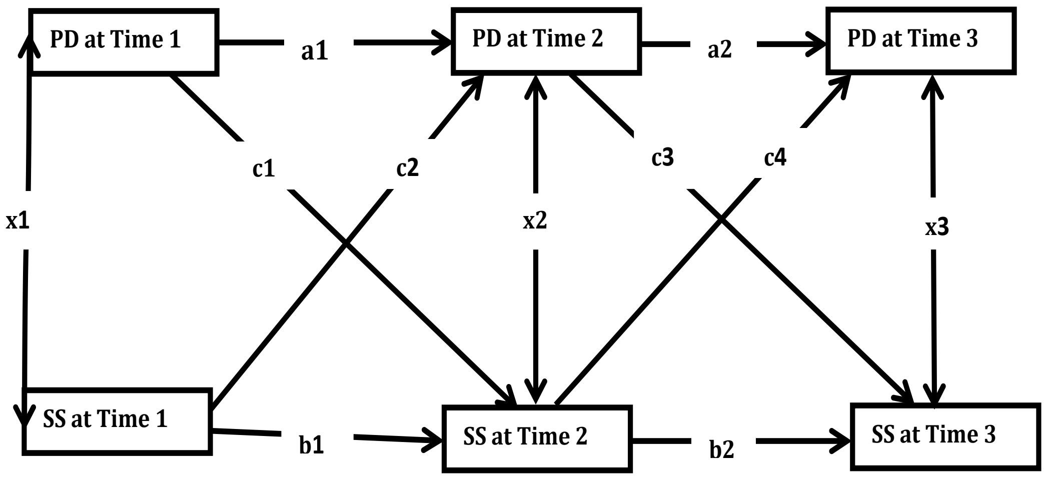
Research Questions

1. Is there any positive association between study skills and program difficulty over time (T1, T2, and T3)
2. Are program difficulty and study skills consistent or stable across study levels (T1 to T2, and T2 to T3)
3. Does program difficulty cause or influence study skills or vice versa?
4. Is there a difference in PD and SS across 300, 400, and 500-level pharmacy students?

Conceptual Framework and Hypotheses Development

The relationship between PD and SS over time from the perspective of undergraduate pharmacy students is a largely under-researched area in education. To address the research objectives presented, a cross-lagged path model was developed from repeated cross-sectional data collected from pharmacy students over a 3-time point period based on the level of study from three purposively selected pharmacy schools in southwestern Nigeria - Olabisi Onabanjo University, Ogun state, University of Ibadan, Oyo state, and Obafemi Awolowo University, Osun state.

Figure 1. Conceptual diagram of the Cross-lagged study



Key:

PD at time 1=perceived program difficulty for third-year students; **PD at time 2** perceived program difficulty for fourth-year students; **PD at time 3** perceived program difficulty at fifth-year students; SS **at time 1**= study skills of third-year students; **SS at time 2**= study skills of fourth-year students; **SS at time 3**= study skills of fifth-year students

Figure 1 shows the three key relationships inherent in the cross-lagged model with data obtained over three time points- T1 (part 3 students), T2 (part 4 students), and T3 (part 5 or final year students): 1) Unlagged paths or correlations between two variables at the same time point. This is indicative of the consistency of the relationship at that time point (represented by covariance double-headed arrows-x1, x2, and x3), 2) autoregressive path or stability coefficients which show how stable the variables (PD and SS) are over time (represented by single-headed arrows with a1, a2, b1, b2), 3) reciprocal or cross-lagged paths. This shows the direction of effects or causation between two variables over time (represented by single-headed arrow paths c1, c2, c3, and c4). Furthermore, if the cross-lagged coefficient c1 is stronger than c2, and c3 is stronger than c4, it can be surmised that PD has more effect on SS (or vice-versa). In a case where the cross-lagged coefficients (c1 vs. c2 and c3 vs. c4) are not statistically different, causal effects can be deduced. Similarly, if the cross-lagged paths are not statistically significant, a causal effect is not achieved [Kearney, 2016; Alamer & Lee, 2021].

Specifically, the hypotheses of the study hinged on the following positions (conceptions) namely: a) the association between PD and SS per class level (Time points) is proposed to be positive, b) the more students' perceived PD increases or decreases, it is assumed that it is associated with an increase or decrease in the level of SS adopted at that particular time point. Conversely, c) SS displayed in each academic class (that is, per time point), the less impact (negative effect) it should have on PD in the next time point. On the other hand, PD per time point would predict or create a positive influence or impact on the subsequent SS at the next time point.

Unlagged path (correlational) effects

H1- PD has a consistent positive association with SS at each point in Time (T1, T2, and T3) denoted by x1, x2, and x3.

Autoregressive path

H2- Students' PD tends to strengthen over time [PD is stable or consistent over time (T1 to T2)] designated as path a1 and (T2 to T3) designated as path a2

H3- Students' SS tends to strengthen over time [SS is stable or consistent over time (T1 to T2)] designated as path b1 and (T2 to T3) designated as path b2

Cross-lagged path

H4- PD has a negative causal effect on SS over time (T1 to T2) designated as path c1
H5- SS has a negative causal effect on PD over time (T1 to T2) designated as path c2
H6- PD has a positive causal effect on SS over time (T2 to T3) designated as path c3
H7- SS has a negative causal effect on PD over time (T2 to T3) designated as path c4.

METHODS

Participants and study design

The study is a descriptive repeated cross-sectional survey focused on tertiary-based pharmacy students from three public Universities- Olabisi Onabanjo University, Ogun State (101), University of Ibadan, Oyo State (93), and Obafemi Awolowo University, Osun State (158), situated in southwest, Nigeria. The study participants consisted of 195 (55.4%) females and 157 (44.6%) males with an average age of 22.80 years (SD=2.37). Participants were grouped or partitioned according to their class level- 300 level (*N*=118), 400 level (*N*=115), and 500 level (*N*=117) respectively. The repeated cross-sectional survey involves data collection from a new set of respondents at successive time points (Pan, 2021; Rafferty et al, 2015; Yee & Niemeier, 1996). It typically involves collecting similar or the same information from different respondents over time, thereby providing information to support the analysis of respondents' behavior at the population level. This is because repeated cross-sectional data does not give micro-level information at the individual level (Rafferty et al, 2015; Pan, 2021). The repeated cross-sectional study design involved three separate sets of data collected based on the year of the studentship (that is, third, fourth, and fifth-year students). This approach was adopted by the authors to capture possible changes in the perception of PD and SS unique to each class level in the study population [Dornyei, 2007; Kim & Kim, 2016], without subjecting a group of students to the strain of data collection over a period of 3 years. In other words, repeated cross-sectional studies assess the pattern of change over time at the aggregate or population level of pharmacy students.

Participants included in the study were restricted to students in Part 3, 4, and 5 levels respectively. Students in Parts 1 and 2 were excluded because they were not considered sufficiently knowledgeable or experienced in the faculty. The three time points were predetermined at Time 1 (year 3 students), Time 2 (year 4 students), and Time 3 (year 5 students). The cross-lagged path data analysis employing latent construct measures repeatedly over time was used to model autoregressive and cross-path relationships in the developed model [Kearney, 2016]. Cross-lagged path analysis was used because it helps to determine causal precedence between variables over some time [Kearney, 2016; Kline, 2016]. This model compared correlation and path coefficients between measured latent variables from one time point to another [Kearney, 2017].

Sample size and sampling

The estimated sample population of 900 students in the third, fourth, and fifth study years from the three institutions, using the Krejcie and Morgan (1970) sample size calculator for finite populations, was determined, and a sample size of 254 was determined. A stratified random sampling approach using a web-based structured questionnaire to anonymously collect data with a minimum of 80 respondents from each institution (20-25 respondents from each class level). A final sample of 352 respondents was obtained. For studies involving structural equation modeling (SEM), a sample size greater than 200 respondents is adequate to give reliable and valid results [Strang, 2015; Hair et al, 2019].

Measurement of Variables

The latent variables or constructs were measured on a Likert-type scale. The study skills (SS) questionnaire was adapted from instruments in extant literature [Liao et al, 2021; Didarloo & Khalkhal, 2014; Aboagye et al, 2020; Dolphine et al, 2022] and also adapted from the Study Skills Assessment Questionnaire developed by the University of Houston with 12 measurement items on a 5-point Likert scale of '*never*' to '*always*', while the Program Difficulty (PD) measurement scale was adapted from studies [Liu et al, 2021; Erhun et al, 2022; Jegede et al, 2020b], and was measured by 10 items on a 4-point Likert scale ('*strongly agree' to 'strongly disagree*').

Table 1. Assessment of Measurement Scale [factor loadings and reliability coefficients]

Construct	Description	Factor loading	CR	CA
Program Difficulty (PD)			0.893	0.880
P1	Overall, pharmacy courses are difficult to comprehend	0.432		
P2	Pharmacy training is physically demanding and stressful	0.738		

P3	My time studying pharmacy is entirely occupied	0.745		
P4	My program affords me little time for recreation	0.729		
P5	I spend most of my time on studies	0.756		
P6	My coursework load is quite overwhelming	0.696		
P7	I read for long hours before grabbing the concepts taught	0.656		
P8	Pharmacy training is very stressful compared to other disciplines	0.695		
P9	If given a choice, I prefer a lighter workload than I currently have	0.510		
P10	Leisure time is not always available for me	0.587		
Study Skills (SS)			0.844	0.836
S1	I am eager to ask questions in class whenever in doubt	0.373		
S2	I set up a daily schedule to study and complete assignments	0.604		
S3	I readily use the internet and library sources to supplement my learning	0.488		
S4	I set study goals and make sure I meet them	0.573		
S5	I take notes during class lectures	0.554		
S6	I make summaries of lecture notes in my own words	0.582		
S7	I anticipate exam questions and make sure I master them	0.602		
S8	I follow course outlines to make I am up to date	0.574		
S9	I plan ahead of time by using a to-do-list	0.608		
S10	I set up study goals for each course and devote time to attaining them	0.620		
S11	I recall easily the things I have studied	0.457		
S12	I study with the intent of remembering	0.543		

Note: CR=composite reliability, CA=Cronbach alpha

In Table 1, the measurement model of the instrument revealed that the item standardized factor loadings were between 0.432 to 0.756 for PD and 0.374 to 0.620 for SS, which are considered satisfactory. This is based on the recommendation of Costello and Osborne (2005) and Hair et al (2019), which affirmed that factor loadings for measurement items measuring a construct were deemed adequate if greater than 0.3. We assessed the reliability and consistency of the instrument (questionnaire) used for the study with composite reliability (acceptable values above > 0.7) and Cronbach alpha (acceptable values above 0.7). The results as presented in Table 1 showed that composite reliability and Cronbach alpha were above the stipulated cut-offs.

Pilot study

To verify the psychometric appropriateness of the research instrument, a pilot study using 30 randomly selected pharmacy students was conducted. According to Hair et al. [2006], the measurement scales for PD and SS achieved acceptable internal reliability (Cronbach alpha values greater than 0.7), and composite reliability values were 0.78 and 0.9 respectively (CR>0.7).

Cross-lagged path Analysis

A cross-lagged model addresses reciprocal lagged relationships between constructs or variables over different time points [Kearney, 2016; Morrow & Congor, 2011; Kock, 2023]. Cross-lagged path analysis provides evidence of reciprocity or causation between two or more variables or constructs over time. These models have two key parameters to be established- stability coefficient and cross-lagged effects [Kearney, 2016]. Stability coefficients are the path coefficients that reflect how a construct is stable or consistent over time while cross-lagged paths provide evidence for the direction of causality from one construct to another [Kline, 2016; Kearney, 2017]. Causal predominance is determined by comparing the standardized path coefficients of the cross-lagged paths or reciprocal relationship/s [Kline, 2016]. In determining the direction of causality, the variable or construct with a stronger reciprocal effect is referred to as the source variable, while the variable with the lower effect is known as the effect variable [Kearney, 2017]. In other words, using cross-lagged analysis, this study seeks to investigate how PD predicts or influences SS or vice versa. And is the causal effect (SS to PD and/or PD to SS), the same as students' transition from one study class to another? Therefore, these causal relations over time are best captured or investigated using cross-lagged panel analysis compared to other techniques [Kline, 2016].

Assumptions of Cross-lagged Model

According to Kearney (2016), the following assumptions guide studies that use cross-lagged models, namely: 1) Synchronicity which states that the measurement of a variable occurs at the same point in time over time points 2) Stationarity which assumes that variables and estimated relationships remain the same over time. In other words, it assumes stability of variables over time, 3) Timeframe of effects which asserts that the influence of a variable on another variable occurs over time.

Data analysis

Composite-based structural equation modeling using Advanced Analysis of Composites software (ADANCO 2.4.1) developed by Henseler and Dijkstra, (2015) was used for hypotheses testing. The analysis of variance (ANOVA) test was used to compare the mean scores of SS and PD. Based on Collier's (2020) recommendations normality assessment of data distribution to confirm the range of skewness and kurtosis showed the adequacy of data based on the acceptable range of -2 to +2.

Ethical consideration

Ethical approval for the study was given by the Ogun State Health Research Ethics Committee [OGHREC/467/139]. The purpose of the study was introduced to the students before questionnaire administration. Respondents' information was kept anonymous and confidential.

RESULTS

Reliability and Validity of Constructs

Table 2. ***Mean standard deviation, Correlational, and Reliability Analysis of key constructs***

Constructs	PD1	SS1	PD2	SS2	PD3	SS3
PD1						
SS1	0.041					
PD2	0.046	0.004				
SS2	-0.144	0.053	0.132			
PD3	-0.127	-0.033	-0.118	0.025		
SS3	-0.024	-0.248**	0.072	0.106	0.229**	
Mean	30.11	49.06	31.41	47.81	30.92	47.27
SD	5.33	7.27	4.31	7.63	5.34	7.63
N	118	118	116	116	117	117
CR	0.853	0.711	0.811	0.833	0.902	0.882
CA	0.827	0.703	0.701	0.815	0.899	0.854

Note. **p<0.01, SD=standard deviation, N=number of participants in group, CR=composite reliability, CA=Cronbach alpha

Key:

PD1=perceived program difficulty for third-year students; **PD2**=perceived program difficulty for fourth-year students; **PD3**=perceived program difficulty at fifth-year students; **SS1**= study skills of third-year students; **SS 2**= study skills of fourth-year students; **SS3**= study skills of fifth-year students

Table 2 showed that a significant negative correlation (r=-0.248, p<0.001) existed between SS1 and SS3 which means that an increase in SS at time 1 is associated with a decrease in SS at time 3. Conversely, a positive and significant correlation (r=0.229, p<0.001) exists between PD3 and SS3 which suggests that an increase in PD at time 3 is associated with a corresponding improvement in SS at the same time. An analysis of the mean scores showed that compared to PD, SS had higher values. The internal reliability of the measures was adequate with Cronbach and composite reliability values above the 0.7 benchmark [Collier, 2020].

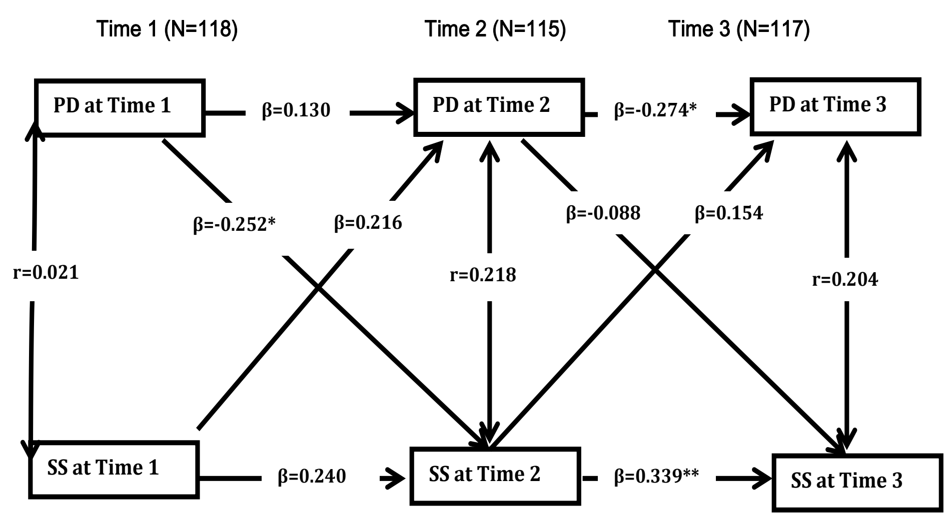
Analysis of group differences based on PD and SS

Using summary data from Table 1, a one-way between-subject ANOVA was conducted to compare the difference in PD and SS across class levels-300L, 400L, and 500L undergraduate pharmacy students. The results showed that there was no significant difference between the three groups in PD [F (2, 347) =1.996, p=0.137], and also, there was no significant difference between the three groups in SS [F (2, 347) =1.757, p=0.174]. These findings imply that perceptions of PD and SS are stable and/or consistent among students. However, the cross-lagged analysis will provide further insights into the time-related changes across class levels of PD and SS [Kearney, 2016; Kline, 2016].

Evaluation of the Cross-Lagged Model.

We assessed the model fit adequacy of the cross-lagged model using measures of discrepancy (squared Euclidean distance-d_{ULS} and Geodesic discrepancy-d_G [Henseler, 2020] and absolute fit indexes such as standardized root mean squared residual-SRMR which should be less than 0.08 recommended by Hu and Bentler (1999) or less than the upper limit of 0.1 for factor-based models [Kock, 2017]. Discrepancy measures should have values below or between HI95 [95% percentile (or α=0.05)], and HI99 [HI99= 99% percentile (or α=0.01)] to show adequate fit. The model had an SRMR value of 0.0875, d_{ULS}=1.94 [1.63-0.89], and Geodesic discrepancy-d_G=0.65 [0.61-0.72] which were generally within acceptable levels. Hence, the model fits the data adequately.

Figure 2. Cross-lagged model showing path relationships between SS and PD over three-time points



Note: *p<0.05, **p<0.01

An evaluation of the model indicated that the correlations between PD and SS were not statistically significant at 3-time points, although they had positive associations: correlation coefficient r = 0.021, p >0.05 at Time 1, r =0.213, $p>0.05$ at Time 2, and r =0.204, $p>0.05$ at Time 3. Hence, hypotheses **H1a, H1b**, and **H1c** were partially supported as presented in **Table 3.**

Table 3. ***Path coefficients for Cross-lagged path model (Hypotheses Testing)***

Structural paths	Path	r/β-value	t-value	p-value	Hypotheses
Unlagged effects (correlation)					
PD1 <----> SS1	**X1**	0.021	n/r	>0.05	**H1a**: partial support
PD2 <----> SS2	**X2**	0.219	n/r	>0.05	**H1b**: partial support
PD3 <----> SS3	**X3**	0.204	n/r	>0.05	**H1c**: partial support
Autoregressive effects					
PD1 ----> PD2	**a1**	0.130	0.929	0.177	**H2a**: not supported
PD2 ----> PD3	**a2**	(0.274)	-2.038	0.042*	**H2b**: supported
SS1 ----> SS2	**b1**	0.240	1.484	0.069	**H3a**: not supported
SS2 ----> SS3	**b2**	0.339	2.969	0.002**	**H3b**: supported
Cross lagged effects (reciprocal)					
PD1 ----> SS2	**c1**	(0.252)	-1.957	0.025*	**H4**: supported
SS1 ----> PD2	**c2**	0.216	1.025	0.153	**H5**: not supported
PD2 ----> SS3	**c3**	(0.088)	-0.631	0.264	**H6**: not supported
SS2----> PD3	**c4**	0.154	0.907	0.182	**H7**: not supported

Note. **p<0.01, *p<0.05, r=correlation coefficient, bracket represents negative value, 1=time T1, 2=time T2

Analysis of Cross lagged model

From the study findings, as presented in Figure 2, and Table 3, we can affirm that the autoregressive path or stability coefficient for PD from T1 to T2 (a1; β=0.130, p>0.05; H2a not supported). Also, PD from T2 to T3 (a2; β=-0.274, p<0.05) was statistically significant (H2b supported) which depicts an increase in perception of the difficulty of the program. Also, stability coefficient for SS from T1 to T2 (β=0.240, p>0.05; not significant; H3a not supported), and SS from T2 to T3 (β=0.339, p<0.01; was significant; H3b supported). This shows that SS was strengthened or improved significantly as students progressed from the penultimate to the final year.

Next, we compared the stability coefficient of PD and SS across T1 to T2, and from T2 to

T3. Therefore, the stability coefficient of PD (β=0.130, t-value=0.929) and SS (β=0.240, t-value=1.484) from T1 to T2 was significantly different in favor of PD (path a1 as shown in Figure 1) which had a higher value. However, the stability coefficient of PD (path a2; β=-0.274) and SS (path b2; β=0.339) from T2 to T3 was significantly different in favor of SS (path b2) which had a higher value. This finding of differences between autoregressive paths (T1 to T2, and T2 to T3) revealed a tendency of PD to decrease over time (coefficient of PD dropped from β=0.130 to β=-0.274). Also, students' perception of SS increased from β=0.240 to β=0.339 ($p<0.01$),

Furthermore, examining the reciprocal or cross-lagged path coefficients showed that PD at time 1 had a significant weakening effect on SS at time 2 (β=-0.252, $p<0.05$; H4 supported). This shows PD for students in the third year predicted or influenced their study skills in their fourth year. However SS at time 1 had a positive but insignificant effect on PD 2 (β=0.216, $p>0.05$; H5 not supported) for T1 to T2.

An analysis of reciprocal effects for T2 to T3 showed that PD at time 2 had a negative but insignificant influence or impact on SS at time 3 (β=-0.088, $p>0.05$; H6 not supported). Similarly, the impact of SS at time 2 on PD at time 3 was positive but also insignificant (β=0.154, $p>0.05$; H7 not supported). Therefore, because of the non-significant path coefficients of the cross-lagged or reciprocal effects at Time 2 to Time 3, no comparative analysis was made between paths c3 and c4.

DISCUSSION

The main objective of the study was to explore the relationship between study skills (SS) and perceived program difficulty (PD) of pharmacy students across three academic levels- 3rd, 4th, and 5th years of study using cross-lagged panel analysis. The basis for this investigation is to investigate the directionality of the effect from SS to PD and vice versa. By extension, discuss the implications of the study outcomes for undergraduate pharmacy education.

As presented in Table 2, SS generally had higher mean scores compared to PD across all levels of study by students. This is further supported by the fact that students tend to develop better study skills adequate to address their perceived PD which is substantially attributed to more developed academic competence and relative experience in managing heavy study load and curriculum requirements [Sansgiry et al, 2016; Kleijn, 1994]. However, the ANOVA results depicted that among undergraduate students, there is no apparent difference between the levels based on the perception of PD and SS. This finding aligns with the assertion of Smith et al. (2007) that negligible evidence was available to substantiate maturation in study and learning styles among Australian students as they progressed through the pharmacy curriculum. In this regard, the time-dependent changes were examined using the cross-lagged analysis approach.

A key finding of the cross-lagged analysis of the study is that PD at time 1 only had a causal effect on SS at time 2, and the autoregressive effects were significant from PD at time 2 to PD at time 3. This implies that students' perception of PD at time 1 (300 level) influenced their adoption of SS at time 2 (400 level). The reduction of perceived PD from time 2 to time 3 is suggestive that as students get more study experience, they tend to apply themselves better to the intensity of the program, thereby accounting for the decrease in effect. This is supported by the assertion of McKiernan et al. (2020) which showed that SS enables students to select, adjust, and modify their study patterns according to the level of PD experienced. Therefore, as recommended by Stegers-Jager (2013), pharmacy educators should incorporate integrated study skills programs based on their knowledge of difficulty across class levels.

Furthermore, the study findings imply that academics should use knowledge of PD measures to identify academic difficulties encountered by students as they progress from one level to the other, to provide needed support systems [Liu et al, 2021; Choi et al, 2019]. In the same vein, in line with the recommendations of Liao et al. (2021), academic administrators should ensure that early, direct, and sustainable steps to instill better study habits among students are implemented. This has a defining effect on enhanced performance over time. This information aligns with the recommendations of Sansgiry et al. (2005) regarding the need for a review of the volume of academic work which may impede or pose a challenge to the ability of students to cope.

There are recommendations to be gleaned from the findings of the study;

1. The comparative analysis of the mean scores for PD and SS revealed that the scores tend to be stable or consistent as students progress in class level. Therefore, this finding suggests that students adapt to the academic rigors and demands with time. By extension, lecturers should provide support and guidance to students as they transition from one level to another.
2. Students should be adaptable, and hardworking, and adjust their SS based on the PD of individual subjects or courses and perhaps the particular class level.
3. Focus on improving the learning environment from the teaching perspective to participative and interactive learning to enhance active student participation is advised [Smith et al, 2007; Jegede et al, 2024]. In other words, the more engaging and interactive a class is, the more easily students assimilate and recall information when required in an exam or test.
4. To the best of the authors' knowledge, this is the first study to empirically establish that the direction of causation effect is from PD to SS, not SS to PD. This means that PD influences SS, and not the other way around.
5. In a nutshell, the study affirms that students' perception of PD tends to influence SS and not the other way around, especially at lower class levels. In other words, an average pharmacy undergraduate student's ability to modify their studying pattern or habits depends on perceived difficulty (PD).
6. Finally, it is recommended that educators adopt a granular teaching approach that combines traditional teaching with the learning needs of undergraduate pharmacy students [Williams et al, 2013; Keshishian & Brenton, 2015; Gnjidic et al, 2023].

Conclusion

The study of the relationship between adoption and use of study skills and perceived program difficulty among pharmacy students is essential to improve performance outcomes among students. The study addressed the relationship of the constructs by applying a cross-lagged analysis model which revealed that program difficulty tends to reduce as students progress through the academic ladder. Similarly, the study affirmed that program difficulty influences students' tendency to adapt their study skills. The study provided evidence that students tend to develop better study skills as they advance in their undergraduate studies. We advanced a cross-panel model of study-program difficulty to measure time-related changes in students' perception of the relationship between program difficulty and study skills over the three final years of undergraduate pharmacy students in Nigerian Universities. Finally, the developed cross-lagged model answers the question of the direction of causality between study skills and perceived program difficulty which may inform improvement in curriculum development with a primary focus on students' overall academic welfare. Educators and curriculum developers should use evidence to adjust course demands to lessen the academic burden on students and provide early, regular study skills training to support their journey in undergraduate pharmacy school. Finally, the model by extension is applied to evaluate and assess students' perceptions of other academic disciplines.

Limitations and Future Directions

There are several limitations of the study: first, the sample of students was only from three Universities in the southwestern part of Nigeria. Hence there is a need to extend the scope of the study beyond regional borders. Also, there is a need to cross-validate the findings of the study across other students from other disciplines. Furthermore, since a pseudo-longitudinal approach was used, it is imperative to replicate the study using longitudinal data.

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