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Scale Validation and Impact of Program Difficulty and Study Habits on Performance among Undergraduate Pharmacy Students

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Abstract

Study habits and program difficulty in the context of academic performance are critical considerations among undergraduate pharmacy students. However, a robust, validated measurement instrument is absent to evaluate the relationship between study habits, program difficulty, and academic performance from students' perspectives. 352 undergraduate pharmacy students [195 (55%) females and 157 (45%) males] from 3 public Universities in Nigeria were surveyed. Structural equation modeling was used to develop and test the model validity using exploratory and confirmatory factor analysis (EFA and CFA) respectively. EFA extracted a three-factor structure aligned with theorized framework. CFA revealed adequate model fit and construct validity. Measurement invariance analysis showed configural, metric, scalar, and residual invariance by gender, age, class, and University. Study habits positively influenced students' performance while program difficulty had a negative impact. We propose a robust, validated instrument-program difficulty, study habits, and academic performance scale useful for academicians, educational and curriculum managers. The study concludes that the developed psychometric scale is a robust, versatile self-reported instrument for assessing the impact of study habits and program difficulty on the academic performance of students.

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INTRODUCTION

In tertiary institutions, the attainment of the desired degree or qualification is considered the ultimate reflection of academic performance. Academic performance is affected by the study habits of students as well as the impact of perception of program difficulty amongst other factors (Didarloo & Khalkhali, 2014; Aboagye et al., 2020). Extensive research on study habits has been conducted among students in tertiary institutions (Didarloo & Khalkhali, 2014; Aboagye et al., 2020; Sariem et al., 2014; Erhun et al., 2022). Study habits are indicative of the strategies adopted by students to improve comprehension and achieve academic success (Sansgiry et al., 2006: Sariem et al., 2014). Several study habits strategies such as time management, group learning, social skills, study strategy, and academic competence have been known to contribute significantly to students' academic performance (Sariem et al., 2014; Erhun et al., 2022). Specifically, in pharmacy schools, appropriate cultivation of study habits has been examined to be cardinal to sustained performance (Didarloo & Khalkhali, 2014; Aboagye et al., 2020). Study strategies are coping mechanisms adopted by students to manage the challenges of their academic work to achieve academic performance. Furthermore, study skills are strategies adopted by students to overcome the enormous workload before them typified by time constraints, coping with lecture schedules, comprehending and memorizing important materials, test preparation, seeking clarification, and note-taking (Delphine et al, 2020). The learning needs of pharmacy students are premised on perceived program difficulty attributes such as heavy academic load, time constraints, high stress levels, perceived negative perception of the teaching environment, and the cost of the program (Marshall, 2008; Keshishian & Brenton, 2011). However, to the best of the authors' knowledge, there is no available validated and parsimonious research instrument that measures the key constructs of academic performance, study habits and program difficulty among undergraduate pharmacy students in Nigeria, and perhaps globally.

Literature Review

Academic performance refers to the attainment of desired outcomes or output such as test or exam scores, course grades, and grade point average (Didarloo & Khalkhali, 2014; Aboagye et al., 2020). Also, academic performance has been affirmed to be a consequence of the study habits of students as well as perceived program difficulty (Xhomara, 2021; Didarloo & Khalkhali, 2014; Aboagye et al., 2020). This is pertinent because adequate evaluation of study skills coupled with lowered perception of program difficulty is important for proper assessment of the capacity of students to achieve desired academic success. However, no study has evaluated the usability or appropriateness of an integrated scale measuring study habits questionnaire incorporating perceived program difficulty and self-reported academic performance among undergraduate pharmacy students.

Study habits are acquired or learned behaviors of students that involve the use of methods that are assumed to positively influence the learning process to deliver the desired academic output by the student (Sansgiry et al., 2006: Sariem et al., 2014). These habits albeit self-learned, differ from individual to individual and may positively or adversely impact academic performance which separates poor performing from high-performing students (Zimmerman, 2005; Sariem et al., 2014; Odiri, 2015; Colthorpe et al., 2019; Mckieman et al., 2020). Some of these habits cover domains such as reading skills, time management, test preparation, note-taking, and memorizing (Sansgiry et al, 2006; Odiri, 2015; Ezeala & Siyanga, 2015; Aboagye et al., 2020; Delphine et al., 2022). However, most studies have used several questionnaire-based tools to evaluate study habits, without using a measurement tool that incorporates the context of program difficulty and academic performance in a single validated instrument (Liao et al., 2021; Delphine et al., 2022; Didarloo & Khalkhali, 2014; Jegede et al., 2020; Aboagye et al., 2020).

Perceived program difficulty refers to the perception of pharmacy students relating to the challenging nature of the academic program. (Marshall et al, 2008; Frick et al., 2011; Choi et al., 2019: Liu et al, 2021). Choi et al., (2019) and Erhun et al., (2022) enumerated some factors responsible for high perceptions of program difficulty among pharmacy students. They include- test anxiety, stress, low-grade point average, poor grades, failing a course, repeating a class or reseating a failed course, and coping with the adjustments required to succeed in the program. According to Frick et al., (2011), stressful academic conditions in undergraduate pharmacy programs (poor teaching facilities, lecturer support, course load, time constraints, etc.) differ based on study level; as students in higher classes tend to adjust better compared to those in lower classes.

According to Dimitriv (2014), Boateng et al., (2018), and Lamm et al., (2020), it is a methodological requirement for scale development and validation process to assess the reliability and validity of a proposed scale before acceptance as a research tool. Hence, there is a need to comprehensively evaluate the psychometric properties of the proposed instrument. According to Hinkin, 1995 and Boateng et al., 2018, the methodological framework for the development of a measurement scale involves the use of critical processes such as item generation, sampling and survey, factor analysis or item reduction, reliability and validity testing, and measurement invariance testing. In addition, to support group comparisons, psychometric tools should be evaluated for measurement invariance using multigroup confirmatory factor analysis to determine its robustness across groups in a study population (Putnick & Bornstein, 2016; Oamen et al., 2022). Therefore, we computed measurement invariance to determine configural, metric, scalar, and residual invariance across demographic groups based on age, gender, study class, and University attended.

Research Problem

Presently, there is no known study with a validated integrated instrument or validated scale to measure the construct validity and measurement invariance (across gender, age, class, and Universities) of program difficulty, study habits, and academic performance of undergraduate pharmacy students. Furthermore, this validation study is relevant to educational managers for three main reasons; 1] curriculum managers require a tool to identify and review the effectiveness of teaching methods and their impact on students' perceptions, and 2] most studies focused on study habits tend to lack the context of perceived program difficulty and impact on performance of students, and 3] a parsimonious measurement scale is required which can be applied across multiple institutions, and robust enough to accommodate the demographic attributes of students.

Research Questions

Is there a valid model encompassing program difficulty and study skills questionnaire for undergraduate pharmacy students?

Is the instrument equivalently measuring the perception of students based on gender, age, study class, and University attended?

Do program difficulty and study habits influence the academic performance of pharmacy students

Objectives of the study

The main objectives of the study are;

To validate the Program Difficulty and Study Habits Questionnaire

To determine measurement invariance of developed instrument across gender, age, and class levels

To assess the effects of program difficulty and study habits on the academic performance of pharmacy students (Path analysis).

METHOD

Study design

A cross-sectional survey design was used for the study. Participants are undergraduate pharmacy students randomly selected from three purposively selected Universities in southwest, Nigeria.

Study area

Survey data was collected from undergraduate pharmacy students (N=352) from three government-owned tertiary institutions- Olabisi Onabanjo University, Ogun State (n=101), University of Ibadan, Oyo State (n=93), and Obafemi Awolowo University, Osun State (n=158), situated in southwest, Nigeria. At the time of conducting the research, all three selected Universities offer pharmacy as a bachelor degree course (Bachelor of Pharmacy).

Participants and Procedure

Participants for the study were undergraduate pharmacy students (N=352) enrolled in the faculty of pharmacy from three public Universities situated in southwest, Nigeria. About 45% (n=157) are male and 55% (n=195) female. The mean age of respondents was 23.0 years (SD=2.4) with a range of 17 to 30 years. Self-reported measures were used considering that students' perception is critical feedback to support change in educational settings (Hakim, 2014). Face and content validity was also determined by a group of expert researchers in pharmacy education. Ethical approval was given by the Ogun State Health Research Ethics Committee with no-OGHREC/467/139. Data collected took place over 2 months (March to April 2024).

Inclusion and exclusion criteria

Undergraduate students were recruited if they were a) bonafide registered pharmacy students, b) willing to participate, and c) were in their third, fourth, and final year of study respectively. Students were first-year students were not in the faculty yet, and second-year students were considered inexperienced to give valid or reliable views on the research topic.

Sample size determination and data collection

The sample size of 352 respondents was used for the analysis. Generally, for studies involving structural equation modeling (SEM), a sample size greater than 200 respondents is adequate to obtain reliable and valid results (Strang, 2015: Hair et al., 2019).

Data Analysis

Statistical package for the social sciences (SSPS) was used for descriptive statistics and the Harman single factor test. Covariance-based structural equation modeling (CB-SEM) in Analysis of Moment Structures (AMOS) version 24 was used to develop and validate the psychometric properties of the proposed instrument.

Normality assessment of data

Normality assessment of data distribution using the maximum likelihood method of estimation to confirm the range of skewness and kurtosis to determine the adequacy of data based on the acceptable range of -2 to +2 (Collier, 2020). The analysis showed that the values for skewness (-0.023 to -0.986) and (-0.005 to 1.118) for kurtosis. Hence, the data satisfied normality assumptions.

Measurement Invariance testing of Questionnaire

Measurement invariance testing is relevant to ensure that possible group differences are not due to measurement problems due to the framing of the questionnaire instrument. Measurement invariance testing confirms that the group members understand the questionnaire the same way or equivalently (Oamen et al., 2022). Four parameters are used to test invariance between stipulated groups; 1] configural invariance that considers the baseline fit indices of the model by confirming the factor structure of the model assumed to be equal across groups; 2] metric invariance (also known as weak factorial invariance) measures the factor loadings of items forming each construct is equal across groups; 3] scalar invariance (also known as strong factorial invariance) considers the mean values of the items measuring the construct across groups; and 4] residual invariance (also known as strict invariance) considers the unmeasured variance of each indicator item as equal across groups (Putnick & Bornstein, 2016; Oamen et al., 2022). Residual invariance is considered the highest level of equivalence of a measurement model, thereby affirming the basis of comparison of a scale across groups (van de Schoot et al, 2015).

According to Cheung & Rensvold (2002), Chen (2007), Putnick & Bornstein, (2016), and Oamen et al (2022), the recommended criteria to establish invariance is- the absolute difference between the baseline and constrained models expressed as differences in Tucker Lewis Index (ΔTLI) and difference in Comparative Fit Index (ΔCFI) are within the range of perfect=0 and acceptable≤ 0.01, and change in root mean square error of approximation (ΔRMSEA) ≤ 0.015 for metric, scalar, and residual invariance using the configural model as a baseline, and thereafter the differences between the Metric vs. configural, scalar vs. metric, and residual vs. scalar.

In the study, using a multigroup CFA, four main groups were considered- gender (male vs. female), age (below 20 vs. above 21 years), class (part 3 vs. part 4 vs. and part 5), and the University attended by study participants.

Measurement of Variables

The latent constructs were measured by reflective indicators or measurement items and were measured on Likert-type scales. Study Habits were measured by 13 indicators with a 5-point Likert scale from *never (1)* to *always (5),* Program Difficulty was measured by 10 items with a 4-point Likert scale ranging from *strongly disagree (1)* to *strongly agree (4)*, and Academic Performance was measured by 10 indicators on a 5-point scale of *poor (1)* to *good (5).*

Common Method Bias (CMB)

For self-reported questionnaire instruments involving similar Likert-type scales for questions, researchers are faced with the increased likelihood of respondents filling the questionnaire with similar answers or responses without conscious effort, hence introducing biased results or responses. Therefore, datasets derived from a Likert-scale type questionnaire should be examined for CMB using the Harman Single Factor test (Podsakoff et al, 2003). In this method, using a single factor un-rotated principal component analysis in SPSS, the responses to 31 measurement items were evaluated. The single factor obtained accounted for 20.76% of the variance which is less than the cut-off measure of > 50% (Podsakoff et al, 2003). Hence, there are no CMB concerns with the data; therefore it is suitable for further analysis.

RESULTS AND DISCUSSION

Exploratory factor analysis

An initial EFA analysis was conducted on the dataset using the principal axis factoring extraction method and Promax rotation method (assumes correlated factors) in SPSS with measurement items or indicators retained with factor loadings above or equal to 0.4 (Stevens, 2012). The analysis revealed that items PD1, SS1, and SS4 were removed because of low factor loadings. Item AP5 was removed because it has cross-loadings with another item of another construct. In conclusion, 31 items were reduced to 27 due to the removal of 4 items. The three factors or constructs extracted in total accounted for 43.03% of the variance explained by the measurement items. At the individual construct or factor level, Study habits (11 items) accounted for 15.43%, Difficulty (9 items) accounted for 8.14% and Academic Performance accounted for 19.46 % (7 items).

Confirmatory factor Analysis (CFA) of Dataset

A CFA was conducted on the dataset to confirm the 3-factor structure of the research instrument based on the following indices- model fit, convergent validity, discriminant validity, and a multigroup CFA approach was used for evaluating measurement invariance testing of the instrument across subgroups of the demographics of the students.

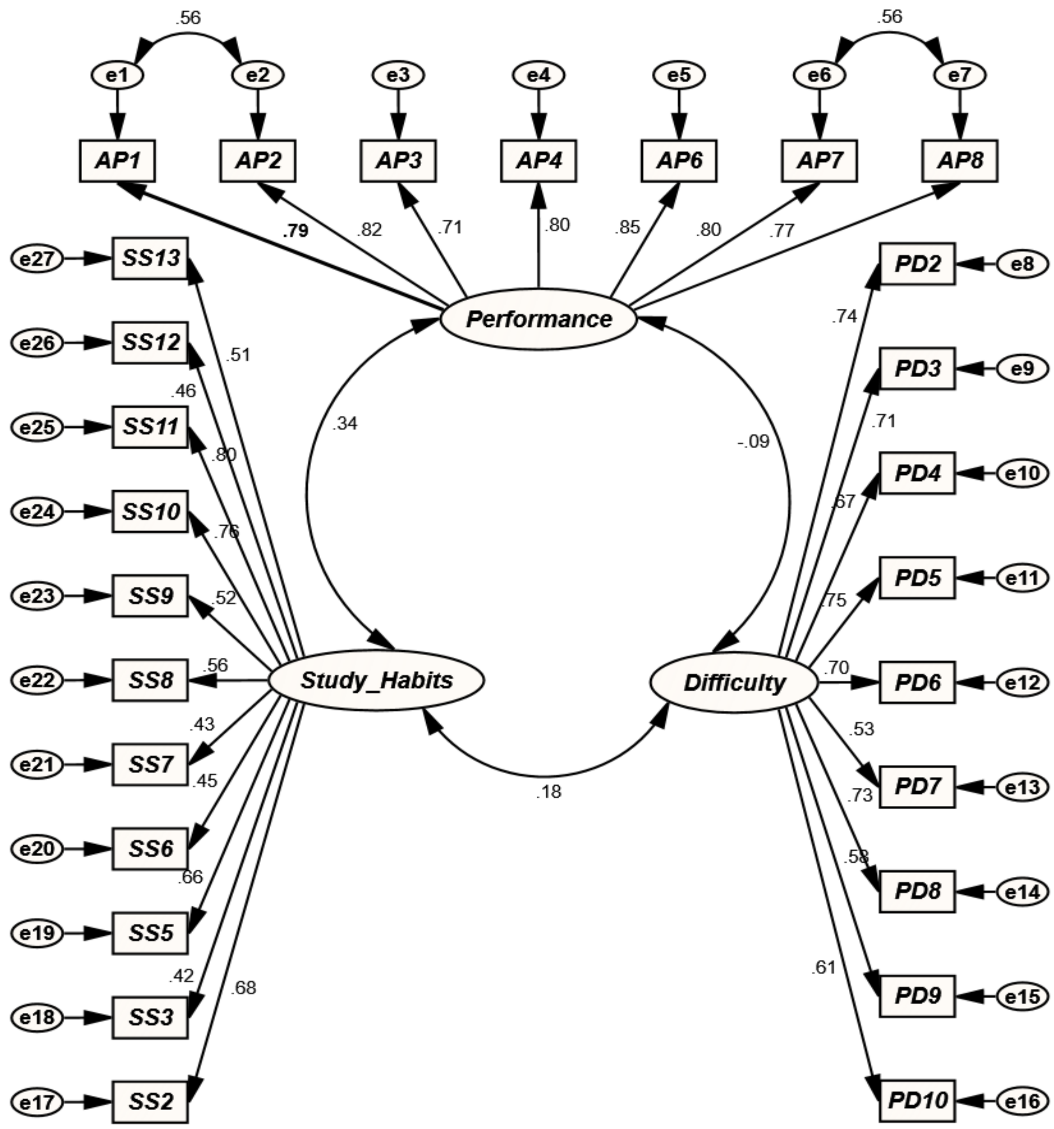

Figure 1. Measurement Model of the Research Instrument

The CFA measurement model depicted in figure 1 showed the final factor loadings (standardized regression coefficients) of the indicators or measurement items for each construct- study habits (11 indicators), program difficulty (9 indicators), and academic performance (7 indicators).

Model Fit Indices of Instrument

The initial CFA gave a correlated 3-factor structure with the following model fit attributes- $\chi 2/df=2.886$ (<3 is acceptable), absolute fit indices-root mean square error of approximation (RMSEA) =0.073 (90% confidence interval [0.068, 0.079] where equal or below 0.05 as acceptable, and standardized root mean squared residual (SRMR)=0.060 (≤0.08 is the acceptable value). Also, comparative indices obtained were Tucker Lewis Index (TLI)=0.852 (>0.90 is considered acceptable), and comparative fit index (CFI)=0.865 (>0.90 is considered acceptable) based on the recommendations of Hu & Bentler (1999) and Hair et al (2019).

To establish a better model fit of the instrument based on the recommendations of Collier (2020) and suggestions provided by the modification indices in the software program AMOS, the error terms of theoretically substantiated relationships between measurement items or indicators of the same construct were made. For instance, error terms e1 and e2 from the academic performance construct were correlated as well as e7 and e8. The rationale was that '' I am doing better in my courses now compared to before'' (e1) is thematically related to '' my course scores are better now than before'' (e2). Also, ''my comprehension and retention ability has improved over time'' (e7) is similar to '' my understanding of course concepts has improved appreciably'' (e8). The final optimal model with better or improved fit indices was thereafter obtained- $\chi 2/df=2.197$, absolute fit indices-root mean square error of approximation (RMSEA)=0.058 (90% confidence interval [0.053, 0.064], standardized root mean squared residual (SRMR)=0.0583, Tucker Lewis Index (TLI)=0.906, and comparative fit index (CFI)=0.915.

Table 1. Internal reliability and consistency of the Measurement Model (Convergent validity)

Construct	Indicators	Code	FL	CR	CA
Study Habits				0.843	0.842
	1. I am eager to ask questions when in doubt about things taught	SS1	**		
	2. I set up a daily schedule to study and complete assignments	SS2	0.678		
	3. I readily use the Internet and library resources to supplement my learning	SS3	0.416		
	4. I read when it is most suitable/convenient with minimal distractions	SS4	**		
	5. I set study goals and ensure I meet them	SS5	0.664		
	6. I take notes during class lectures	SS6	0.446		
	7. I make summaries of lecture notes in my own words	SS7	0.425		
	8. I anticipate questions to be asked in exams and ensure I know the answers	SS8	0.561		
	9. I follow course outlines to ensure I am up to date on requirements	SS9	0.522		
	10. I plan ahead of tests by using a to-do-list	SS10	0.764		
	11. I set up study goals for each course and devote time to attaining them	SS11	0.797		
	12. I recall easily the things I have studied	SS12	0.461		
	13. I study with the intent of remembering	SS13	0.505		
Program					0.876

Difficulty				0.881	
	1. Overall, pharmacy courses are difficult to comprehend	PD1	**		
	2. Pharmacy training is physically demanding and stressful for me	PD2	0.737		
	3. My time studying pharmacy is entirely occupied	PD3	0.714		
	4. My program affords me little time for leisure/recreational activities	PD4	0.672		
	5. I expend a lot of my time on my studies	PD5	0.747		
	6. My course load is quite overwhelming	PD6	0.702		
	7. I have to read for long hours to grab the concepts taught	PD7	0.534		
	8. I think pharmacy is very stressful compared to other disciplines	PD8	0.733		
	9. If given a choice, I prefer a lighter workload than I currently have	PD9	0.579		
	10. Leisure time is not always available for me	PD10	0.606		
Academic Performance				0.922	0.927
	1. I am doing better in my courses now compared to before	AP1	0.789		
	2. My course scores are better now than before	AP2	0.824		
	3. I meet my set academic goals as planned	AP3	0.711		
	4. My present study habits have benefited my grades	AP4	0.802		
	5. Group study has improved my learning ability	AP5	**		
	6. My academic grades have improved over time	AP6	0.846		
	7. My comprehension and retention ability have improved over time	AP7	0.800		
	8. My understanding of course concepts has improved appreciably	AP8	0.768		

Note. FL=factor loadings (standardized), CR=composite reliability, CA=Cronbach alpha, **=items removed due to factor ladings below 0.4 in EFA

Based on the recommendations of Hair et al (2016), it is relevant to verify the internal validity (composite reliability), consistency, and reliability (Cronbach alpha) of the instrument which should be generally greater than 0.7. As presented in Table 1, the measurement model showed that study habits, academic performance, and program difficulty exceeded the benchmark for convergent validity. Therefore, the proposed measurement scale consistently, reliably, and adequately measures the indicators forming the constructs or variables.

Table 2. Discriminant Validity of Instrument (Heterotrait Monotrait)

Constructs	1	2	3
1. Academic Performance			
2. Program Difficulty	0.114		
3. Study Habits	0.348	0.114	

To establish the uniqueness of each construct as distinct from the others, the strict HTMT criterion value of less than 0.85 recommended by Henseler et al (2015) was used. As presented in Table 2, the results showed that the HTMT value ranged from 0.114 to 0.348. Hence, the separability of the academic performance, program difficulty, and study habits was confirmed,

Table 3. Measurement Invariance testing of Instrument based on Gender

Model	χ2/df	TLI	CFI	RMSEA	ΔTLI	ΔCFI	ΔRMSEA	Inference
Configural	1.713	0.890	0.900	0.045	0	0	0	Acceptable
Metric	1.693	0.893	0.900	0.045	0.003	0	0	Acceptable
Scalar	1.751	0.885	0.887	0.046	0.008	0.003	0.001	Acceptable
Residual	1.790	0.879	0.876	0.048	0.006	0.011	0.002	Acceptable

Note. Δ=differences are in absolute values, χ2=Chi-square, df=degrees of freedom, TLI=Tucker Lewis Index, CFI=comparative fit index, RMSEA=root mean square error of approximation

Table 4. Measurement Invariance testing of Instrument based on Age

Model	χ2/df	TLI	CFI	RMSEA	ΔTLI	ΔCFI	ΔRMSEA	Inference
Configural	1.707	0.891	0.901	0.045	0	0	0	Acceptable
Metric	1.677	0.895	0.901	0.044	0.004	0	0.001	Acceptable
Scalar	1.654	0.899	0.901	0.043	0.004	0	0.001	Acceptable
Residual	1.624	0.904	0.902	0.042	0.005	0.001	0.001	Acceptable

Note. Δ=differences are in absolute values, χ2=Chi-square, df=degrees of freedom, TLI=Tucker Lewis Index, CFI=comparative fit index, RMSEA=root mean square error of approximation

Table 5. Measurement Invariance testing of Instrument based on Class

Model	χ2/df	TLI	CFI	RMSEA	ΔTLI	ΔCFI	ΔRMSEA	Inference
Configural	1.518	0.882	0.893	0.039	0	0	0	Acceptable
Metric	1.513	0.883	0.889	0.038	0.001	0.006	0.001	Acceptable
Scalar	1.513	0.883	0.883	0.038	0	0.006	0	Acceptable
Residual	1.526	0.88	0.874	0.039	0.003	0.009	0.001	Acceptable

Note. Δ=differences are in absolute values, χ2=Chi-square, df=degrees of freedom, TLI=Tucker Lewis Index, CFI=comparative fit index, RMSEA=root mean square error of approximation

Table 6. Measurement Invariance testing of Instrument based on University attended

Model	χ2/df	TLI	CFI	RMSEA	ΔTLI	ΔCFI	ΔRMSEA	Inference
Configural	1.578	0.870	0.883	0.041	0	0	0	Acceptable
Metric	1.548	0.876	0.882	0.040	0.006	0.001	0.001	Acceptable
Scalar	1.543	0.877	0.877	0.039	0.001	0.005	0.001	Acceptable
Residual	1.588	0.867	0.860	0.041	0.010	0.017	0.002	Acceptable

Note. Δ=differences are in absolute values, χ2=Chi-square, df=degrees of freedom, TLI=Tucker Lewis Index, CFI=comparative fit index, RMSEA=root mean square error of approximation

Based on the results presented in Tables 3, 4, 5, and 6, it was reliably affirmed that there is measurement equivalence between subgroups of the study population because the absolute difference in parameter values between the Metric vs. configural, scalar vs. metric, and residual vs. depicted by ΔTLI, ΔCFI, and ΔRMSEA was generally within the stipulated range. This supports the relevance of the tool across demographic disparities with the guaranteed equivalence of measurement.

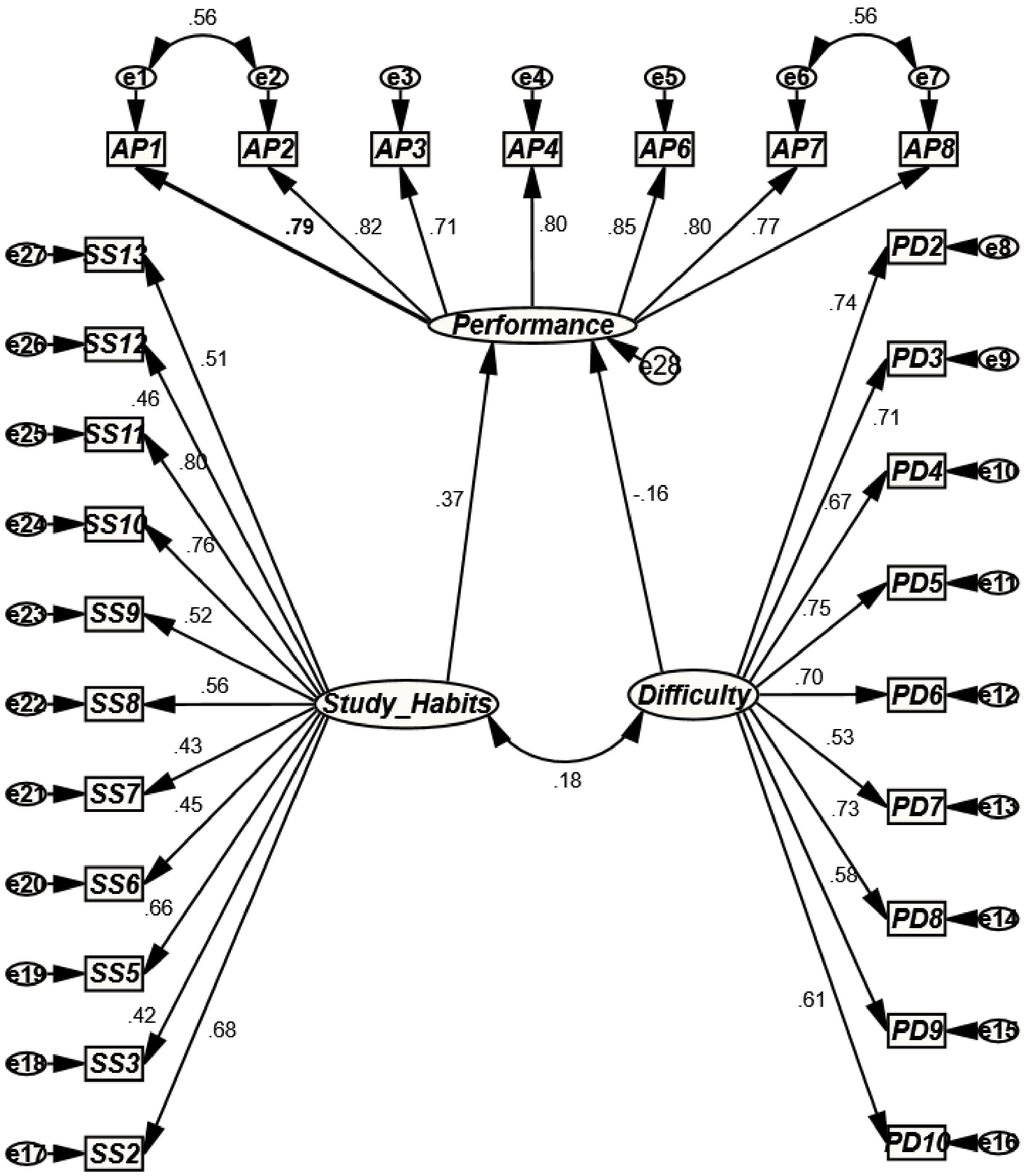

Figure 2. Full structural model depicting the effects of Study Habits and Perceived Program Difficulty on Performance of Pharmacy Students

The full structural model (Figure 2 and Table 7) showed that study habits had a positive effect or influence on academic performance ($\beta=0.373$, $p<0.01$) and perceived program difficulty had a negative effect on academic performance ($\beta=-0.160$, $p<0.006$). Therefore, these opposing effects suggest that when educational managers develop measures to enhance students' study habits and decrease the perception of the difficulty of subjects taught, better performances from students would be enhanced.

Furthermore, study habits and perceived program difficulty are positively correlated (r=0.18, p=0.005) which implies a positive association (an increase in perceived program difficulty is associated with an increase in study habits of students).

Table 7. Direct effects of program difficulty and study habits on academic performance

Direct effects	β	t-value	p-value	Inference
Study Habits ---------->Performance	0.373	5.846	0.001	positive effect
Program Difficulty ----->Performance	(0.160)	-2.754	0.006	negative effect

Note. B=standardized regression coefficient, p<0.01 (at t>1.96)

Undergraduate studies in the medical sciences especially pharmacy is considerably difficult and perhaps may place a toll on performance outcomes. Although many studies have addressed the key constructs of perceived program difficulty, study habits, and academic performance. There is a need to develop a parsimonious and valid measurement scale that integrates these constructs to measure students' perceptions. Therefore, the present study validates the psychometric properties of the measurement scale; and secondly, addresses the effects of the independent variables (program difficulty and study habits) on the dependent variable (academic performance).

The results of this study followed the methodological framework for the development of a measurement scale-item development from relevant literature, scale development, and scale evaluation which encompasses processes such as item generation, sampling, and survey method used, factor analysis, reliability, and validity testing, (CFA), and measurement invariance testing (Hinkin, 1995; Boateng et al, 2018). The optimum invariance quality of the tool (PDSH_MS) across gender, age, class levels, and University groups validate the robustness and versatility of the instrument among undergraduate pharmacy students (Swift et al, 2019). Therefore, the excellent psychometric properties and measurement invariance quality of the scale enhance the applicability of the tool in other can be extended to other academic disciplines.

The study outcomes suggest that pharmacy curriculum development to support improved academic performance should include a periodic assessment of perceived program difficulty and study habits using the developed self-reported instrument- Perceived Difficulty and Study Habits Measurement Scale (PDSH_MS), to inform necessary adjustments to ease the difficulty and intensity of courses taught.

Based on the results of the study, from the structural path analysis (Table 7 and Figure 2), the comparative impact of the study habits of students on their academic performance was stronger than the effect of perceived program difficulty. This finding is corroborated by Kleijn et al, (1994) and Sansgiry et al (2006) that students tend to evolve and develop better study behavior as they learn to navigate through the demands of their studies. Therefore, the PDSH_MS provides useful information on the relative impact of perceived program difficulty and study habits on academic performance. Thereby an empirical and practical linkage between the constructs is established. As a result, the study provides academic administrators with empirical evidence to support decisions based on the evaluation of students' perceptions using a validated research instrument.

The study is the first developed measurement scale to produce empirical information for educators to support student-centered policies thereby improving academic performance. The study outcomes add to the discourse on educational management for pharmacy students by providing important information to help managers modify the study environment for students thereby enhancing desired performance.

Implications of the study to educational managers

Construct scores of the instrument can be used to quantitatively assess the domains of difficulty, study strategies, and academic performance. Hence, enhances the overall improvement in domains over time. Therefore, the periodic use of the validated instrument to evaluate possible improvements or declines in key constructs among students. The integrated nature or attribute of the instruments supports a holistic assessment of student's academic performance by educators. Thus, it supports early identification of the impact of new educational interventions on students' performance in the context of students' attention to developing adequate study strategies.

The study explored the sensitivity of the instrument across age, gender, study class, and university attended. Thereby, the analysis provided empirical evidence that the instrument will guarantee equivalence and unbiased results across the demographics of students sampled. This underlies the essence of conducting measurement invariance testing as part of the psychometric validation of research instruments (Putnick & Bornstein, 2016; Oamen et al., 2022). An important benefit of the measurement invariant tool is that it justifies comparisons between subgroups due to the improved psychometric sensitivity of the instrument (Swift et al, 2019). Therefore, the PDSH_MS instrument is essentially free from biased results or measures due to measurement.

Consequently, the robustness of the instrument implies that it can be administered with confidence across varied demographic groupings of students, thereby, supporting use or applicability across contexts. Therefore, the developed instrument can be extended to other academic disciplines. The study provides empirical evidence to support educational managers' student-centered policies thereby improving academic performance. The study buttresses the need for routine or periodic review of students' perceptions by educational and curriculum managers.

Limitations of the study and future research direction

The study was based on data collected from three public Universities situated in the southwestern part of Nigeria. Hence, extrapolation of findings to other regions or cultural contexts should be done with caution. However, the homogenous nature of pharmacy students and their academic history are relatively similar thereby the developed instrument is robust. The present study adopted a cross-sectional study approach. Hence, a longitudinal investigation of the tool is required to explore its stability and sensitivity over time.

CONCLUSION

The study is perhaps the first to incorporate study habits, program difficulty, and self-reported academic performance into a validated measurement scale. This psychometric study validates PDSH_MS as a robust and reliable measure of undergraduate students' perception of study habits, program difficulty, and academic performance. The psychometric analysis of the scale confirmed the adequacy of the instrument to support the measurement of constructs by educational managers, academics, and curriculum developers. The instrument allows researchers to understand and explore students' academic coping capacity by robust analysis of the structural relations between key constructs both on an individual and collective basis. For educational managers and curriculum developers, data from the PDSH_MS provide useful information to analyze the impact of interventional programs and curriculum reviews on students' performance. Evidence provided by this tool would support objective analysis by curriculum developers on the effects of teaching methods and academic workload on students' performance. From the students' perspective, this self-reported measure enables subjective analysis of academic progress as they progress from one academic level to another. Finally, this psychometric instrument demonstrated the versatility and robustness of the tool by establishing equivalence of understanding, comprehension, and response across age, gender, study level, and Institution attended.

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