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Development of Pedagogical Competence Scale for Lecturers in Universities Using Item Response Theory

Barakat Adeoti Olagunju✉[1] & Rukayat Oyebola Iwintolu[2]

[1,2] College of Education, Osun State University, Ipetu- Ijesha, Osun State, Nigeria

✉ barryspicy@yahoo.ca

Abstract: To ascertain whether lecturers had the pedagogical competency skill needed in impacting students with necessary skills they need outside school, this study developed a scale to measure Lecturers' Pedagogical Competence (LPCS) in universities using item response theory. The pedagogical competence of university lecturers was assessed using a set of items designed and evaluated the scale's construct validity. The initial scale consisted of a 70-item four options Likert-type. The multi-stage sampling procedure was employed. Proportional sampling was used to choose four universities in South Western Nigeria. At each of the institutions selected, 20% of the staff population was selected from all faculties using stratified random sampling with a cadre as a stratum. Thus, 906 lecturers from federal universities and 294 were selected from federal state universities, respectively. In all, 1,086 of the 1200 lecturers selected completed the study's instrument. The results showed that four of the six optimal factors underlying lecturers' pedagogical competence were reliable. Eventually, 20 can measure LPC. Furthermore, the LPCS showed validity by optimally measuring the theoretical construct underlying the scale. Evaluation of learning outcome; managing student behavior during lecture; using ICT to Enhance learning; and lecturers' student interaction remains the most important factors in LPCS.

Keywords: Lecturers, Competence, Pedagogy, Item Response Theory

1. Introduction

Fundamentally, education is a process that uses teaching and learning to transfer and acquire knowledge and skills in specific competencies. It is the development of human capital formation and mobilization of manpower that is needed to achieve sustainable growth and development in a nation. Schooling is a channel through which societies can attain steady democracy with the view to be self-reliant in building a society in which everybody will have an equal opportunity of being represented. After secondary education, the next level is higher education, which culminates with a public certificate examination required for admission to higher education. Similarly, higher institutions of learning include colleges, mono-technics, polytechnics, and universities, and those institutions offering correspondence courses.

According to the Federal Republic of Nigeria (2014), the National Policy on Education made some major reforms and innovations in 2014 by introducing into the Nigerian educational system goals that would assist university education and contribute positively to national development. Thus, the view of the goals could be achieved through high-level relevant manpower training; development and institution of suitable cultural and social values into students from different backgrounds; development of effective teaching methods to enhance students' intellectual capability towards understanding and appreciating their immediate environments; development of resourceful competence skills needed outside the school that would empower students to be self-reliant in the society; award scholarships to deprived students as a form of community service; promotion of national unity among students through integration; and, promotion of national and international interaction among indigenous and foreign students.

Despite the reform introduced by the national policy on education in 2014, it is frightening to mention that lots of difficulties still obstruct university education development in Nigeria. For

instance, the former Minister of Education, Mallam Adamu Adamu corroborated these with a speech given at a retreat for Governing Councils of Nigeria federal government-owned universities by ascribing some of the critical issues that required urgent attention in Nigerian Universities to infrastructure, and facilities, curriculum update, quality assurance, governance, and leadership style, and funding among others (National Universities Commission, 2019).

From the prior on the low quality of graduates in various universities, the former minister of education noted that about fifteen to thirty percent of instructional and infrastructural facilities are non-functional, ancient, and broken down. All aforementioned factors have a clear adverse consequence on the quality of teaching and learning outcomes for graduates from Nigerian universities, as research and experience have it that only a few graduates are employable with adequate competence and skills. Meanwhile, many of them lack the requisite skills needed for employment. Consequently, to assess and ascertain whether lecturers had the pedagogical competency skill needed in impacting students with the necessary skills they need outside school related to self-reliance, there is a need to develop a pedagogical competency scale that would measure the competency level of lecturers in Nigerian Universities using a modern approach for efficiency and consistency in addressing the various crucial issues encountered by Nigerian Universities.

1.2. Problem Statement

Challenges in the university system highlighted in different studies were accredited to curriculum updates, grave shortage of qualified employable professional lecturers, inappropriate teaching pedagogical competency among lecturers, over-reliance of lecturers on research articles and publications which reduces their commitment towards efficient teaching, the inability of lecturers to validate their subject content, inadequate and ancient infrastructures and equipment's, insufficient funding, extended strike from inconsistent industrial action, reduced library facilities; among others. These may have accounted for little connection to the knowledge and skills students need outside the school, which obviously may lead to reasons given by employers as to why many Nigerian University graduates have remained unemployed. In Nigeria, the goals of university education also seem unachievable because universities have a shortage of valid and reliable measurement scales that could enhance lecturers' pedagogical competence, and university graduates most times are, not able to combine knowledge and skills acquired in schools compare with what obtains in the job market; hence the need for this study.

1.3. Related Research

Pedagogical knowledge and skills are associated with how the teacher teaches and incorporates curriculum, such as getting to know the students, usage of instructional materials, theories of learning, ideologies, and strategies in classroom management, measurement, evaluation, and decision-making. Shulman (2008) suggested that it is not sufficient for a teacher to have academic knowledge of a subject matter, but in addition, the ability to impart the source of knowledge, its causes, its interaction with other areas, and why the students should learn that body of knowledge. It can also be seen as general information that includes teaching qualification, in-depth knowledge about learning methods and practices covering student learning, classroom management, lesson plan development and execution, and assessment. A teacher with deep pedagogical knowledge understands how the student develops the knowledge, how he gains the skills, or how they develop positive tendencies toward learning.

The pedagogical competence of lecturers can be defined as the ability of lecturers to coordinate learning that includes planning, implementation, and evaluation of learning outcomes of students in tertiary institutions. Shulman (2008) explained pedagogical competence as the ability to design, implement, evaluate, and understand learners needed skills through learning outcomes in actualizing different capabilities. According to Darling-Hammond (2010), teachers' pedagogical competency is one of the most powerful determinants of student achievement. Lecturers are expected to be highly qualified, and skillful, and should be with vigor, which would make them mentally ready to impact competently on their students. If lecturers' professional pedagogic competence is established,

it would give shape and improvement to the quality of education acquired in tertiary institutions.

In addition, the pedagogical competence of academic staff can be described in two parts. The first is the ability of a lecturer to apply his/her pedagogical skills; while the second is related to the quality of the lecturer as a role model in terms of students' professional development. In the same vein, lecturers' quality education can enrich the life of the students who intend to become professional teachers or an instructor in the future. Lecturers according to Ryegard et al. (2010) should be able to understand students' capabilities on a topic, think about how students can learn things differently even when they encounter difficulties in the process of learning, and not discriminate against students.

1.4. Research Objectives

It is logical to say that the levels of students' academic performances are highly influenced by their teachers' attributes and competencies. If they are apathetic, uncommitted, uninspired, lazy, unmotivated, immoral, and anti-social, the whole nation is doomed. In recognition of this fact, therefore, pedagogical competence should be given a major emphasis in all teaching activities in the university system. Many kinds of research have been conducted on pedagogical competence especially teachers' pedagogical competence in primary and secondary schools including its measurement in the school system, however, few studies have provided a systematic evaluation of the measures of Lecturers' pedagogical competence, especially in Nigeria. Although, measures such as the teacher efficacy scale (Adewolu, 2006; Gibson & Dembo, 1984) and teacher effectiveness (Kumar & Mutha, 2013) have been developed. While such measures have exhibited acceptable internal consistency statistics, few have been appraised using a rigorous approach such as IRT to establish the factors that could enhance the construct of lecturers' pedagogical competence scale in southwestern Nigeria. The present investigation attempted to resolve these issues by developing a measure of lecturer pedagogical competence scale based on an exhaustive review of previous measures of perceived pedagogical competence using the IRT approach. Hence, the following research questions guided this study:

1. What are the sets of items that will measure the lecturers' pedagogical competence in universities in Southwestern Nigeria?
2. What is the internal consistency of LPCS?
3. Does the LPCS possess construct validity?

2. Theoretical Framework

"Pedagogue" was initially a term for a slave who was responsible for the care of children in the household. Later the meaning of the word expanded to mean educator and teacher. A pedagogic theory deals with the nature and structure of educational action, teaching, and upbringing. Pedagogic theories are connected with belief and value systems, concepts of man and society, and philosophies of knowledge and political interests. In general, the concept of pedagogy refers to a systematic view of organizing education. It discusses the issues of how to educate and what it means to be educated. In this context, a pedagogic theory is a theory of educational action or a systematic view and reflection of pedagogic practice. It deals with processes of raising, teaching, learning, and social and cultural development. Aims and means, values and norms, and objectives and methods of education are thoroughly reflected therein. Somr & Hruškova (2014) suggest the use of Herbartianism theory to explain pedagogy which is the main thrust of this study.

2.1. Herbartianism

Johann Friederich Herbart (1776-1841) is regarded as the father of pedagogy. His works are based on the conceptions of pedagogy. In his theory, he pointed out the five elements of pedagogy, i.e. preparation, presentation, association, generalization, and applications.

Preparation – The tutors are well-aware in terms of the fact that they need to prepare themselves properly before they put into practice the teaching-learning techniques, teaching-

learning materials, and instructional strategies. In preparing themselves well, they need to be well-furnished in terms of concepts, theories, notions, and ideas. When the students are in doubt and are unable to understand the concepts in a well-organized manner, they will put forward questions before the tutors. When the tutors are knowledgeable and well-prepared, they will be able to answer them and contribute significantly to providing solutions to their problems and challenges. Therefore, it is fully understood, preparation is an important element of pedagogy.

Presentation – The tutors as well as the students need to upgrade their presentation skills at all levels of education. Presentation is regarded as a vital element for tutors as they need to give presentations when they are delivering lectures. On the other hand, the students also need to give presentations, as they are regarded as vital evaluation strategies. Hence, individuals need to focus on up- gradation of presentation skills. In honing presentation skills, various factors need to be taken into consideration. These are, providing accurate information, speaking clearly and fluently, maintaining eye contact with the audience, making use of common language, answering questions put forward by the audience, having pleasant facial expressions, inculcating the traits of morality and ethics, possessing technical skills, maintaining the time-frame and dressing neatly. Therefore, presentation is regarded as one of the essential elements of pedagogy.

Association – Association is the process of bringing ideas and events together. When teaching and learning processes are put into practice, the tutors and the students associate various aspects such as memory, imagination, mental connection, thoughts, ideas, viewpoints, and/or sensations. When the students are attending lectures and tutors are communicating with them in terms of the topic with which they are familiar and have experiences, then the students are provided with the opportunities to express their ideas and viewpoints. Hence, the past experiences of the students are related to the subjects and concepts and in this manner, they are able to augment their learning. Therefore, the association is accepted and is considered a vital element of pedagogy.

Generalization – Generalization is referred to the reasoning from detailed facts to general principles. These can be explained as the formulation of general concepts from specific instances. It is a general statement or concept that is obtained by inference from specific cases. The generalizations may not be entirely true, especially in the case of individuals and situations, where generalizations do not apply. The generalization principle requires that the reasons for the action be consistent with the presumption that individuals with the same reasons act the same way. An act that satisfies the generalization principle is stated to be generalizable or to pass the generalization test. Therefore, generalization is considered a key element of pedagogy.

Applications – Applications are putting into practice what is learned. At all levels of education, tutors are teaching students subjects and concepts, so they can make use of the knowledge in achieving personal and professional goals. The educational qualifications, skills, and abilities need to be put into practice in an efficacious manner in leading to the up-gradation of the personal and professional lives of the individuals. Normally, when students are acquiring training in terms of extra-curricular and creative activities, such as the production of artworks, handicrafts, singing, dancing, sports, technologies, and others through getting enrolled in educational institutions and training centers, they augment their knowledge and skills. Furthermore, they make use of their talents either as professions or hobbies. Therefore, it is fully understood that individuals need to be well aware of how to apply the knowledge in enriching their lives.

A good articulation of these five elements of pedagogy as proposed by Herbart is expected to form the basis of lecturers' pedagogical competence.

3. Method

3.1. Research Design

This study adopted a descriptive research design. Data had to be collected from selected members of the entire population (sample) for investigation as it was impractical to access each lecturer in southwestern Nigeria. Collected data from the selected lecturers were analyzed and the result was generalized to be applicable to the entire population of lecturers in southwestern Nigeria. Specifically, data were collected from a sample of lecturers in public universities in southwestern Nigeria.

3.2. Participants

The population for the study was 8,028 which consisted of 5,218 male and 2,810 female lecturers in public universities in the six states in southwestern Nigeria (NUC, 2014). There are six states in the Southwestern part of Nigeria: Ekiti, Lagos, Ogun, Ondo, Osun, and Oyo; each state had federal and state universities. It consisted of lecturers in sciences and humanities with less than 10 years of experience and over 10 years of teaching experience in southwestern Nigerian universities. The yardstick of ten years as a basis for the classification of lecturers as experienced or inexperienced was based on the fact that an average lecturer should be a professional by the time he/she has spent 10 years in the university.

A multi-stage sampling procedure was employed. From each of the six states in Southwestern Nigeria, proportional sampling techniques were used to select four federal and four state universities making up eight universities based on their year of establishment. The federal universities selected are OAU in Osun State, UI in Oyo State, UNILAG in Lagos State, and FUNAAB in Ogun State. In addition, the state universities selected are LASU in Lagos State, EKSU in Ekiti State, LAUTECH in Oyo State, and AU in Ondo State. In each of the federal and state universities selected for the study, 20% of the staff population in each university was selected across all the faculties in each institution using stratified random sampling and cadre as strata. At 20% of staff in each university, 906 lecturers were selected from a total population of 4,534 lecturers at the four federal universities. Meanwhile, 294 lecturers were selected from 1,474 lecturers at the four state universities. A total of 1,086 out of 1200 lecturers completed the instrument used for the study.

3.3. Data Collection

The research instrument developed for this study was titled "Lecturer Pedagogical Competence Scale". Items were generated to effectively measure the pedagogical components of teaching; the scale consisted of two sections;

(a) Section A consisted of respondents' data, such as sex, cadre, institution, highest qualification, discipline, and years of experience.
(b) Section B of the scale consisted of items that probed into the pedagogical competence of lecturers.

It comprised 90 items, which was 47 items drawn from a questionnaire developed by Nwaehutwu (2006). Areas of change included environmental differences, and the remaining 43 items were generated from the literature. The scale consisted of items that probed into nine key areas of lecture activities. They were:

(i) Teaching Qualification
(ii) (Planning Instruction
(iii) Materials Development and Utilization
(iv) Delivery
(v) Managing Students' Behavior during Lectures
(vi) Lecturers'-Students' Interaction
(vii) Evaluation of Learning Outcome
(viii) Research Skills
(ix) Using ICT to Enhance Learning.

The Likert scale type with four options of SD = Strongly Disagree, D = Disagree, A = Agree, and SA= Strongly Agree was adopted. The items on the LPCS consisted of positive and negative statements, which aim to ensure that respondents read and understand them before responding to them and to prevent the response from being set. The positive items had a score of 1, 2, 3, and 4, for SD, D, A, and SA respectively, and vice versa for the negative items. A mean score of 1 and 2 indicates a low level of pedagogical competence, and a mean score of 3 and 4 indicates a strong or high level of pedagogical competence.

The Lecturers' Pedagogical Competence Scale (LPCS) was administered to the sample. The researchers with the assistance of trained personnel in data collection visited the selected institutions in each state simultaneously to administer the research instruments. Approval to administer the instruments was sought from appropriate authorities. The researchers with trained personnel collected the data within two months. Most of the lecturers were unable to complete the instruments immediately, while a few were able to do so immediately.

3.4. Data Analysis

To identify the items that measure the lecturer's pedagogical competence in universities in southwestern Nigeria, the fitness of the hypothesized model was evaluated using the information criteria Akaike information criterion (AIC), and the sample size adjusted BIC (SABIC) Multidimensional graded response model. A confirmatory model of multidimensional graded response was used to assess the internal scale's consistency. To determine the construct validity of the Lecturers' pedagogical competence scale, the Pearson χ2 and the Root Mean Square Error of Approximation (RMSEA) were used.

3.5. Validity and Reliability

The Content Validity Ratio (CVR) and Content Validity Index (CVI) proposed by Lawshe (1975) were used to test the scale's validity. After collating the items evaluated, a Content Evaluation Panel was formed. The Content Evaluation Panel was composed of personnels who are experts in their field. The experts ranged from Psychology (1), Tests and Measurement (3), and university lecturers of low and high cadres (2), with a total of six experts. Each expert rated the items independent of the other experts, as "essential", "useful", or "not necessary". A weighted value is assigned to each rating. Responses from all experts were pooled, and the number indicating "essential" for each item was determined. The CVR was calculated using the formula below:

$$CVR = \frac{N_e - N/2}{N/2}$$

N_e is the number of experts identifying an item essential

N is the total number of experts (N/2 is half the total number of experts)

Criteria for item deletion and retention.

If all experts agree on item= 1.00 (retain)

If more than half agree on item=0.00-0.99 (retain)

If none of the experts agree on item =0.00 (delete)

Using the CVR item deletion criteria, 20 items were expunged from the 90 items initially generated; while the retained 70 items had a CVI of 0.98. Therefore, each of the items retained and the scale were valid to measure the lecturers' pedagogical competence. In addition, a pilot study was conducted at Osun State University, Osogbo, Osun State. Before the administration of the LPCS for the pilot study; the scale was subjected to review by experts in Tests and Measurement, Psychology, and others. They appraised the items based on ambiguity, relevance, and sentence structure. The responses of the lecturers were subjected to analysis; the results confirmed the deletion of the items.

4. Findings

The results are organized around the three research questions.

With regards to the first question (what are the sets of items that have the potential of measuring lecturers' pedagogical competence in universities in Southwestern Nigeria?), two levels of analysis were conducted: Determination of the dimensionality of the pedagogical competence scale and identification of substantial items and factors using the result of IRT factor analysis.

4.1. The Dimensionality of The Pedagogical Competence Scale

To assess the number of dimensions underlying the lecturers' pedagogical competence scale, the responses of lecturers to the scale were subjected to the Item response theory dimensionality assessment procedure. To achieve this feat, the data were calibrated using the graded response item response model under the hypothesis that one dimension fitted the test data. Thereafter, the data set was calibrated under the hypothesis that two dimensions underlie the test and then the fitness of one and two dimensions was compared. If two dimensions fit the data better than one dimension, the data is further calibrated under the hypothesis that three dimensions fit the test data, and the fitness of two dimensions and three dimensions is compared. This procedure continues until the optimal dimension underlying the model is identified. The result is presented in Table 1.

Table 1. The Dimensionality of the Pedagogical Scale

Dimension	AIC	SABIC	logLik	χ2	Df	P
Comparison of fitness of 1 and 2 dimensions to the data						
1	112496.50	112952.90	-55970.23			
2	111187.20	111756.90	-55246.59	1447.276	69	0.000
Comparison of fitness of 2 and 3 dimensions to the data						
2	111187.20	111756.90	-55246.59			
3	110312.30	110993.70	-54741.15	1010.874	68	0.000
Comparison of fitness of 3 and 4 dimensions to the data						
3	110312.30	110993.70	-54741.15			
4	110125.00	110916.40	-54580.48	321.343	67	0.000
Comparison of fitness of 4 and 5 dimensions to the data						
4	110125.00	110916.40	-54580.48			
5	109924.20	110823.90	-54414.08	332.808	66	0.000
Comparison of fitness of 5 and 6 dimensions to the data						
5	109924.20	110823.90	-54414.08			
6	109784.50	110791.00	-54279.26	269.636	65	0.000
Comparison of fitness of 6 and 7 dimensions to the data						
6	109784.50	110791.00	-54279.26			
7	109716.40	110828.00	-54181.19	196.13	64	0.000
Comparison of fitness of 7 and 8 dimensions to the data						
7	109716.40	110828.00	-54181.19			
8	109553.50	110768.60	-54036.77	288.843	63	0.000
Comparison of fitness of 8 and 9 dimensions to the data						
8	109553.50	110768.60	-54036.77			
9	109617.00	110933.90	-54006.50	60.549	62	0.528

Table 1 shows that when the fitness of the one-dimension model was compared to the 2-dimension model, the 2-dimension model fitted the data better (AIC = 111187.20 and SABIC = 111756.90 for 2-dimension was respectively lesser than AIC = 112496.50 and SABIC = 112952.90 for 1 dimension, $\chi2$ (69) = 1447.276, $p < 0.05$). The table further show that a similar trend was observed for the comparison of the fitness of 1 and 2-dimension models, where a more complex model fitted the data was observed for the 2 and 3-dimension models, 3 and 4-

dimension models, 4 and 5-dimension models, 5 and 6-dimension models, 6 and 7-dimension model and 7 and 8-dimension models. But when the fitness of 8 and 9-dimension models were compared, the table showed that 8 dimensions fitted the data better than the more complex 9-dimension model (AIC = 109553.50 and SABIC = 110768.60 for 8-dimension was respectively lesser than AIC = 109617.00 and SABIC = 110933.90for 9 dimensions, $\chi 2$ (62) = 60.549, $p > 0.05$). The result revealed 8 dimensions fitted the data better than other possible dimensions. The result implies that eight possible subconstructs reflect the lecturers' pedagogical competence. However, the sub-constructs and items that are substantial in the measurement of lecturers' pedagogical competence were assessed.

4.2. Identification of Substantial Items and Factors

To identify the substantial items and factors underlying the scale, the scale was calibrated using the exploratory model of full information factor analysis with the Graded response model (also called Multidimensional graded response model) based on the 10 dimensions that fitted the test data. The results are presented as follows.

Table 2. Rotated full Information Factor Loading of the Lecturers' Pedagogical Competence Scale

	F1	F2	F3	F4	F5	F6	F7	F8
IT1	NA	NA	NA	NA	NA	NA	NA	NA
IT2	NA	NA	NA	NA	NA	NA	NA	NA
IT3	NA	NA	NA	NA	NA	NA	NA	NA
IT4	NA	0.646	NA	NA	NA	NA	NA	NA
IT5	NA	NA	NA	NA	NA	NA	NA	NA
IT6	NA	NA	NA	NA	NA	NA	NA	NA
IT7	NA	NA	NA	NA	NA	NA	NA	0.447
IT8	NA	NA	NA	0.433	NA	NA	NA	NA
IT9	NA	NA	NA	NA	NA	NA	NA	0.456
IT10	NA	NA	NA	NA	NA	NA	NA	0.426
IT11	NA	NA	NA	NA	NA	NA	NA	0.506
IT12	NA	NA	NA	NA	NA	NA	NA	0.532
IT13	NA	NA	NA	NA	NA	NA	NA	NA
IT14	NA	NA	NA	NA	0.556	NA	NA	NA
IT15	NA	NA	NA	NA	0.821	NA	NA	NA
IT16	NA	NA	NA	NA	0.711	NA	NA	NA
IT17	NA	NA	NA	NA	0.522	NA	NA	NA
IT18	NA	NA	0.513	NA	NA	NA	NA	NA
IT19	NA	NA	0.527	NA	NA	NA	NA	NA
IT20	NA	NA	0.586	NA	NA	NA	NA	NA
IT21	NA	NA	NA	NA	NA	NA	NA	NA
IT22	NA	NA	NA	NA	NA	0.446	NA	NA
IT23	NA	NA	NA	NA	NA	NA	NA	NA
IT24	NA	NA	NA	NA	NA	NA	NA	NA
IT25	NA	NA	NA	NA	NA	NA	NA	NA
IT26	NA	NA	NA	NA	NA	NA	NA	NA
IT27	NA	NA	NA	NA	NA	NA	NA	NA
IT28	NA	NA	NA	0.767	NA	NA	NA	NA
IT29	NA	NA	NA	0.855	NA	NA	NA	NA
IT30	NA	NA	NA	0.608	NA	NA	NA	NA

IT31	NA	NA	NA	NA	NA	NA	0.734	NA
IT32	NA	NA	NA	NA	NA	NA	0.506	NA
IT33	NA	NA	NA	NA	NA	NA	NA	NA
IT34	NA	NA	NA	NA	NA	NA	NA	NA
IT35	NA	NA	NA	NA	NA	NA	NA	NA
IT36	NA	NA	NA	NA	NA	NA	NA	NA
IT37	NA	NA	NA	NA	NA	NA	NA	NA
IT38	NA	NA	NA	NA	NA	0.427	NA	NA
IT39	NA	NA	NA	NA	NA	NA	NA	NA
IT40	NA	NA	NA	NA	NA	NA	NA	NA
IT41	NA	NA	NA	NA	NA	NA	NA	NA
IT42	NA	NA	NA	NA	NA	0.46	NA	NA
IT43	NA	NA	NA	NA	NA	NA	NA	NA
IT44	NA	NA	0.419	NA	NA	NA	NA	NA
IT45	NA	NA	0.589	NA	NA	NA	NA	NA
IT46	NA	NA	0.603	NA	NA	NA	NA	NA
IT47	NA	NA	NA	NA	NA	NA	NA	NA
IT48	NA	NA	NA	NA	NA	NA	NA	NA
IT49	NA	NA	NA	NA	NA	NA	NA	NA
IT50	0.427	NA	NA	NA	NA	NA	NA	NA
IT51	NA	NA	NA	NA	NA	NA	NA	NA
IT52	0.408	NA	NA	NA	NA	NA	NA	NA
IT53	NA	NA	NA	NA	NA	NA	NA	NA
IT54	NA	NA	NA	NA	NA	NA	NA	NA
IT55	0.477	NA	NA	NA	NA	NA	NA	NA
IT56	NA	NA	NA	NA	NA	NA	NA	NA
IT57	NA	NA	NA	NA	NA	NA	NA	NA
IT58	NA	NA	NA	NA	NA	0.437	NA	NA
IT59	NA	NA	NA	NA	NA	NA	NA	NA
IT60	0.526	NA	NA	NA	NA	NA	NA	NA
IT61	0.436	NA	NA	NA	NA	NA	NA	NA
IT62	NA	NA	NA	NA	NA	NA	NA	NA
IT63	NA	NA	NA	NA	NA	NA	NA	NA
IT64	NA	NA	NA	NA	NA	NA	NA	NA
IT65	NA	NA	NA	NA	NA	NA	NA	NA
IT66	NA	NA	NA	NA	NA	NA	NA	NA
IT67	NA	NA	NA	NA	NA	NA	NA	NA
IT68	NA	NA	0.461	NA	NA	NA	NA	NA
IT69	NA	NA	NA	NA	NA	NA	NA	NA
IT70	NA	NA	NA	NA	NA	NA	NA	NA

Table 2 shows the loading of the items on the extracted factors by parallel analysis found to be underlying the pedagogical scale. The item loading helped in the determination of the items and factors substantial in the measurement of the pedagogical competence of university lecturers. According to Tabachnick & Fidell (2013), an item is substantial if it is loading on a factor greater than or equal to 0.4 and a factor is, in turn, substantial when at least three items load substantially on it. However, when an item loads substantially on two or more factors, the

item is considered inadequate. As such, item is subjected to many interpretations. On the table, NA is an item loading less than 0.4. Table 2 shows that five items (50, 52, 53, 55, 60, and 61) loaded exclusively with factor 1, 7 items (18, 19, 20, 44, 45, 46, and 68) loaded exclusively with factor 3, four items (8, 28, 29, and 30) loaded exclusively with factor 4, four items (14, 15, 16 and 17) loaded exclusively with factor 5, four items (22, 38, 42 and 58) loaded exclusively with factor 6, and four items (7, 10, 11, and 12) loaded exclusively with factor 8. The table further shows that only one item (4) loaded substantially with factor 2, while two items (31 and 32) loaded substantially with factor 7. The result showed that there were six factors (F1, F3, F4, F5, F6, and F8) out of the eight factors underlying the pedagogical scale that have three or more items loading exclusively with them. In all, there are 28 items that have the potential of being used in the measurement of lecturers' pedagogical competence. The items include 7, 8, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 22, 28, 29, 30, 38, 42, 44, 45, 46, 50, 52, 53, 58, 60, 61 and 68.

4.3. What is the Internal Consistency Reliability of LPCS?

To assess the internal consistency reliability of the scale; empirical reliability; an item response theory-based reliability estimate was used. To achieve this, the confirmatory model of multidimensional graded response was used in the calibration of the scale model for the substantial factors and their respective item. The result is presented in Table 3.

Table 3. Internal Consistency of the Lecturers' Pedagogical Competence Scale

Factors	Empirical reliability estimate
F1	0.71
F3	0.78
F4	0.71
F5	0.71
F6	0.63
F8	0.56

Table 3 shows the empirical reliability estimates of the Lecturers' pedagogical competence scale. The results showed the extent to which each of the factors underlying the scale was internally consistent. From Table 3, factor 1, factor 3, factor 4, and factor 5, had a reliability coefficient greater than 0.70, the minimum coefficient for which an estimate was considered reliable. factor 1, factor 3, factor 4, and factor 5 had 0.71, 0.78, 0.71, and 0.71 reliability estimates respectively. Furthermore, factor 6 (r = 0.63) and factor 8 (r= 0.56) respectively recorded reliability estimates less than the minimum benchmark, 0.70. These results showed that four (Factor 1, factor 3, factor 4, and factor 5) out of the eight factors found to underlie the scale was internally consistent, while two (factor 6 and factor 8) were not. The results imply that four out of the six optimal factors underlying the pedagogical scale were reliable. The remaining two unreliable factors and the items hanging on them were removed from the scale.

Table 4 showed the factors underlying the scale and how the items loading on each of the factors were used.

Table 4: Comparison of the Functionality of Lecturers' Pedagogical Competence

	Item no	ITEMS	SD	D	A	SA
F1	**F1**	**Evaluation of Learning**				
1	50	I make the course assessment procedure known to students at the onset				
2	52	I usually utilize students' responses to tests to further deepen their understanding of the courses I teach				
3	55	I make students participate in the development of concepts and applications during lectures				

	Item no	ITEMS	SD	D	A	SA
4	60	I encourage students to do self-assessment				
5	20	I use different evaluation methods suitable for the behavioral objectives of the subject				
F2	**F3**	**Managing Student Behavior During Lecture**				
6	18	I help students to recognize the standards they are aiming at so that they can achieve them				
7	19	I monitor students' academic progress				
8	61	I find time to assess the slow learner				
9	44	I relate course content with a relevant contemporary event during lectures				
10	45	I try to ensure the participation of student who is not comfortably seated during lectures				
11	46	I try to determine what students know about a topic at the beginning of the lecture				
F3	**F4**	**Using ICT to Enhance Learning**				
12	68	I relate with students online in some of my courses				
13	8	I use ICT to develop my note				
14	28	I promote students' use of ICT in their learning				
15	29	I have the knowledge and skills for e-learning				
16	30	I am capable of utilizing the e-marking facility for large classes				
F4	**F5**	**Lecturers' Student Interaction**				
17	14	I provide students with immediate feedback on tests and examinations				
18	15	I relate directly to my students				
19	16	It is important to know one's students individually				
20	17	I am easily accessible to my students				

4.4. Does The LPCS Possess Construct Validity?

To determine the construct validity of the LPCS, the extent to which the developed Lecturers' pedagogical scale can measure the pedagogical competence of university lecturers, and how invariant the scale is in the measurement of federal and state government universities lecturers' pedagogical competence was assessed.

To achieve this, the fitness of the data to model among federal and state universities' lecturers was assessed. Table 5 presents the assessment of the functionality of the scale found to be substantial in the measurement of lecturers' pedagogical competence.

Table 5: Comparison of the Functionality of Lecturers' Pedagogical Competence

Index	
M2(df)	502.5(498)
p-value	0.31
RMSEA_FED	0.0182 (95% C.I = 0, 0.051)
RMSEA_STATE	0.0313 (95% C.I = 0, 0.0523)

CFI	0.962
TLI	0.958

Table 5 shows that the reduced M2 was not significant for the federal and state universities model, which indicates that it did reflect the data well M2 (498) = 500.25, p = .31. The RMSEA for the model was within the acceptable standard (0.02 [C. I.90%: 0, .05] for the federal and the state, the estimate was 0.03 (95% C.I = 0, 0.052)), with a narrowed confidence interval and a decreased upper bound confidence interval value. The evaluation of the other fit indices showed a value higher than the benchmark revealing that the model was fit (CFI = 0.96; TLI = 0.97). Due to the consensus across indices, the model reflected the data appropriately. The result showed that there is no significant difference in the functionality of the lecturers' pedagogical competence scale among federal and state university lecturers. The result implies that the lecturers' pedagogical competence scale measured the theoretical construct underlying the scale optimally. Thus, the scale is adjudged to have construct validity.

5. Discussion

The initial items for the lecturers' pedagogical competence scale were 70. To identify the items that measure lecturers' pedagogical competence in universities in southwestern Nigeria, the determination of the dimensionality of the pedagogical competence scale and identification of substantial items and factors using the result of item response theory factor analysis were conducted. It was revealed from the result that eight possible sub-constructs reflected the lecturers' pedagogical competence. This result agrees with the work of Chingos (2012), to evaluate teaching performance, he divides the items into eight subconstruct. These are infrastructure, curriculum, knowledge/interweaving of the subject matter, methodology, materials, attitude of the professor, evaluation, and student satisfaction. The result also agrees with the findings of Guion & Ironson (1983), they group them into competencies, university information, the role of the university student, orientation and tutoring systems, methodology, and student satisfaction.

To identify the substantial item and factors underlying the scale, the scale was calibrated using the exploratory mode of full information factor analysis with the Graded response model. The results showed that five items (50, 52, 53, 55, 60, and 61) loaded exclusively with factor 1, seven items (18, 19, 20, 44, 45, 46, and 68) loaded exclusively with factor 3, four items (8, 28, 29, and 30) loaded exclusively with factor 4, four items (14, 15, 16 and 17) loaded exclusively with factor 5, four items (22, 38, 42 and 58) loaded exclusively with factor 6, and four items (7, 10, 11, and 12) loaded exclusively with factor 8. The result further showed that only one item (4) loaded substantially with factor 2, while two items (31 and 32) loaded substantially with factor 7. In other words, there were six factors (F1, F3, F4, F5, F6, and F8) out of the eight factors underlying the pedagogical scale that have three or more items loading exclusively on them. In all, there are 28 items with the potential of being used in the measurement of lecturers' pedagogical competence. The items include 7, 8, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 22, 28, 29, 30, 38, 42, 44, 45, 46, 50, 52, 53, 58, 60, 61 and 68. This is in line with the work of Tabachnick & Fidell (2013), who found that an item is substantial if it is loading on a factor greater than or equal to 0.4 and a factor is, in turn, substantial when at least three items load substantially on it. However, when an item loads substantially on two or more factors, the item is considered inadequate.

The empirical reliability estimates of LPCS showed that factor 1, factor 3, factor 4, and factor 5, had a reliability coefficient greater than 0.70, the minimum coefficient for which an estimate is considered reliable. factor 1, factor 3, factor 4, and factor 5 had 0.71, 0.78, 0.71, and 0.71 reliability estimates respectively. Furthermore, the results showed factor 6 (r = 0.63) and factor 8 (r= 0.56) respectively recorded reliability estimates less than the minimum benchmark, 0.70. In other words, four factors (factor 1, factor 3, factor 4, and factor 5) out of the eight factors found to underlie the scale was internally consistent, while two (factor 6 and factor 8) were not. The result implies that four out of the six optimal factors underlying the pedagogical scale were

reliable. The remaining two unreliable factors and the items hanging on them were therefore removed from the scale. The submissions of measurement experts were uniform on the reliability and validity of the measurement instrument. The scale's coefficients of reliability of LPCS (0.71, 0.78, 0.71, and 0.71 respectively) were very good (DeVellis, 2016).

The items on the LPCS showed evidence of validity as LPCS measured the theoretical construct underlying the scale optimally. Thus, the scale is adjudged to have construct validity. These were good enough for declaring the LPCS usable for measuring lecturers' capability of enhancing the success with which lecturing tasks would be discharged. Shulman (2008) posited that pedagogical competence includes those special attributes a teacher possessed that helped him/her guide a student to understand the content in a manner that was personally meaningful. Therefore, the LPCS has shown that the level of individual lecturers' capability in lecturing activities could be demonstrated through managing the student behavior during the lecture, lecturers' student interaction, evaluation of learning outcomes, and using ICT to enhance learning.

6. Conclusion

In conclusion, the 20-item LPCS was found reliable and valid for the measurement of lecturers' pedagogical competence. Evaluation of learning outcome; managing student behavior during a lecture; using ICT to enhance learning; and lecturers' student interaction remains the most important factors in the LPCS. Therefore, the scale can be used to effectively and efficiently assess lecturers in southwestern Nigeria.

Limitation

The study was carried out with the aim of developing a scale to measure the pedagogical competence of lecturers. However, the sample consists of lecturers lecturing at public universities in southwestern Nigeria. This is a limitation of this study. For the scale to be used in international areas. Similar studies on a broader scale that covers more state of the federation (Nigeria) should be conducted to give an idea of what is obtainable in order parts of the country and the world.

Recommendation

The Lecturers' Pedagogical Competence Scale in its final state is recommended for use by policymakers in universities in southwestern Nigeria. Researchers should also adopt the IRT psychometric theory for scale development as it has the advantage of item and sample invariance.

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Conflict of Interest

The researchers declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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