

Predictors of Higher-Order Thinking Skills among Postgraduate Students of Sokoto State University, Sokoto State, Nigeria

*¹Ahmad Tijani Surajudeen ad ²A.H. Folorunsho

¹Department of Curriculum Studies, Faculty of Education, Sokoto State University (SSU), Sokoto, -Nigeria. **Email:** sirajudeenoloje1@gmail.com

²Department of Islamic Law, Faculty of Law, University of Ilorin, Nigeria. **Email:** folorunsho.ah@unilorin.edu.ng

Abstract

This study aimed to investigate the prediction of higher-order thinking (HOTS) skills among postgraduate students at Sokoto State University, Nigeria, based on cognitive dispositions, innovation capacity, research competencies, critical thinking, and problem-solving skills. The current study is underpinned by Bloom's Taxonomy and the constructivist learning theory, which emphasize the significance of cognitive and analytical skills in promoting higher-order thinking. A quantitative research design was employed to investigate the prediction of higher-order thinking skills, and structured questionnaires were used to obtain data from 250 randomly selected postgraduate students from various faculties across the university. Multiple regression and correlation analysis were employed to analyze the collected data. The findings revealed that all the independent variables significantly and positively predicted higher-order thinking skills, and critical thinking and research competencies significantly predicted higher-order thinking skills more than the other independent variables. Cognitive dispositions and innovation capacity also significantly predicted higher-order thinking skills, while problem-solving skills served as a mediating factor in predicting higher-order cognitive performance based on critical thinking skills. The findings of the current study emphasize the need to integrate higher-order research skills, innovation, and problem-solving skills in promoting higher-order thinking skills among postgraduate students. The findings suggest that promoting higher-order thinking skills is crucial in equipping Nigerian graduates with intellectual and cognitive capacities to contribute to the attainment of the Sustainable Development Goals (SDGs) in Nigeria, specifically in quality education (SDG 4), innovation and infrastructure (SDG 9), and sustainable institutions (SDG 16).

Keywords: Cognitive Dispositions, Innovation Capacity, Research Competencies, Critical Thinking, Problem-Solving Skills and Higher-Order Thinking

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Introduction

The importance of developing higher-order thinking skills (HOTS) among postgraduate students is a cornerstone of advanced education and a vital enabler of the Sustainable Development Goals (SDGs). Higher-order thinking skills, which include analysis, evaluation, and creation, as proposed in Bloom's taxonomy, go a step further than the traditional cognitive domain of knowledge acquisition to include critical thinking, creativity, and problem-solving (Anderson & Krathwohl, 2001). In the domain of postgraduate studies, the importance of HOTS can therefore not be overstated, given that it prepares students cognitively to generate new knowledge, innovate, and solve problems to address societal challenges. In the case of Nigeria, and more specifically Sokoto State University, it is therefore vital to enhance HOTS to enable graduates to contribute meaningfully to the implementation of SDG 4, quality education; SDG 9, industry, innovation, and infrastructure; and SDG 16, peace, justice, and strong institutions.

A number of predictors of HOTS have been proposed in the literature, with cognitive dispositions being cited as a foundation for developing higher-order thinking skills (Facione, 2015). In addition, innovation capacity, which refers to the ability to generate new ideas and solve problems creatively, has also been cited as a predictor of HOTS, given that it is a vital cognitive skill for generating new knowledge in higher education (Dyer et al., 2019). Another predictor of HOTS is research competencies, which include methodological skills, data analysis, and academic writing, a skill that is vital for the academic contribution of postgraduate students (Levy & Ellis, 2011).

The importance of developing critical thinking and problem-solving skills is arguably the most cited cognitive skill in the domain of postgraduate studies, given that it prepares students to think logically, solve problems, and apply theoretical knowledge to practical problems (Jonassen, 2014). In addition, it prepares students to think critically, to arrive at logical judgments, and to self-regulate cognitively (Ennis, 2018). These predictors of HOTS are consistent with constructivist theories of learning, which propose that knowledge construction is a cognitive process that requires engagement, reflection, and interaction with problems (Vygotsky, 1978).

There is a need for the development of higher-order thinking skills (HOTS) that is emphasized in postgraduate education outcomes, yet many universities

in Nigeria face the challenge of adequately preparing the minds of the student population for the required higher-order cognitive skills for effective problem-solving and innovation. Although many studies have been conducted on cognitive dispositions, critical thinking skills, and problem-solving skills in isolation from each other and their combined effect on the development of higher-order thinking skills in postgraduate education outcomes, little attention has been given to the combined effect of these variables on the prediction of higher-order thinking skills in postgraduate education outcomes in Nigeria. This is particularly true for the Sokoto State University student population, where little empirical research has been done to investigate the combined effect of cognitive dispositions, innovation capacity, research skills, and critical thinking skills on the prediction of higher-order thinking skills for the postgraduate student population.

Although many studies have been done on the prediction of higher-order thinking skills in postgraduate education outcomes in Nigeria (Yusuf & Alabi, 2020; Okebukola, 2021), little attention has been given to the postgraduate student population in Northern Nigeria universities. This study thus seeks to fill the literature gap by investigating the predictive influence of cognitive dispositions, innovation capacity, research competencies, critical thinking skills, and problem-solving skills on higher-order thinking skills for the postgraduate student population of the Sokoto State University.

The study was informed by a need to bridge this gap by empirically investigating the multidimensional predictors of HOTS among postgraduate students. The significance of the study lies in its ability to provide evidence-based information which can inform teaching approaches, curriculum development, and policies aimed at promoting postgraduate students' learning outcomes. The novelty of the study lies in its integrated approach to HOTS prediction by incorporating cognitive, affective, and skill-based predictors in one model. This provides a comprehensive understanding of HOTS cultivation. By filling the gap in HOTS prediction, the study contributes to theory development by building on constructivist learning theory and Bloom's taxonomy. Moreover, the study contributes to practice by ensuring postgraduate education in Nigeria meets international standards and the SDGs, particularly in terms of quality education, innovation, and institutional development. The findings of the study are expected to provide valuable insights into curriculum development, teaching approaches, and policies aimed

at promoting advanced learning outcomes, which can inform Nigeria's progress in achieving the SDGs.

Theoretical Framework

The study on the predictive influence of cognitive dispositions, innovation capacities, research competencies, critical thinking, and problem-solving skills on HOTS among postgraduate students of Sokoto State University was anchored on two major theoretical perspectives namely: Bloom's Revised Taxonomy of Educational Objectives and Constructivist Learning Theory.

The foundation for understanding HOTS is Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001). The taxonomy is a classification system for cognitive skills that has six hierarchical levels: remembering, understanding, applying, analyzing, evaluating, and creating. The lower-level skills are concerned with recalling and understanding, while the higher-level skills of analysis, evaluation, and creation all relate to HOTS. The taxonomy is relevant in this study as it forms the basis for measuring cognitive skills and provides a window into the role of predictors such as critical thinking skills and research skills in building higher-level skills in individuals. The research skills relate to the higher-level skills of "analyzing" and "evaluating," while innovation capacity is closely related to the highest-level cognitive skill of "creating."

Another theory that complements the cognitive domain of learning according to Bloom's theory is the Constructivist Learning Theory by Vygotsky. This theory focuses on the construction of knowledge by the learner and the social context in which the learner interacts with complex tasks and scaffolding by an expert or a more knowledgeable guide. According to Vygotsky (1978), the learner can only learn in the Zone of Proximal Development (ZPD) that exists between the level of independent performance and the level of performance with guidance and scaffolding by a teacher or an expert. The postgraduate learners' development of higher-order thinking skills is predicted by cognitive dispositions, the research environment, and the opportunities for innovative and problem-based learning.

Another theory that complements the cognitive domain of learning according to Bloom's theory is Astin's Theory of Student Involvement (1984). This theory provides a justification for the importance of student involvement in academic activities and the physical and psychological investment that the student makes in the academic process and the cognitive development that

results from such involvement. Critical thinking and problem-solving involve the student actively and intellectually in the academic process and the development of innovation and research skills that result from such involvement. These three theories provide a justification that higher-order cognitive skills do not result from the learner's cognitive ability but from the learner's ability to learn and the learner's engagement with tasks that intellectually stretch the learner.

In conclusion, the cognitive domain of learning according to Bloom's theory provides a justification for the level of cognitive skills that the study seeks to investigate and the constructivist theory provides a justification for the process of cognitive development and the importance of student involvement in academic activities and the cognitive development that results from such involvement by the learner. These three theories provide a justification that higher-order cognitive skills do not result from the learner's cognitive ability but from the learner's ability to learn and the learner's engagement with tasks that intellectually stretch the learner and provide a justification for the ability of the learner to contribute to the achievement of the SDGs in North-Western Nigeria.

Conceptual Framework

The conceptual framework illustrates the interrelationship between the five predictors—cognitive dispositions, innovation capacity, research competencies, critical thinking, and problem-solving skills—and their impact on the development of Higher-Order Thinking Skills (HOTS) among postgraduate students of Sokoto State University.

The five predictors have distinct roles to play in the development of HOTS. Cognitive dispositions facilitate reflection, innovation capacity enables creativity, research competencies enhance analytical thinking, critical thinking and problem-solving skills provide the student with tools to evaluate and apply what he or she has learned. In all these, the predictors work hand in hand to facilitate HOTS development, namely analysis, evaluation, and creation as identified in Bloom Revised Taxonomy (Anderson & Krathwohl, 2001).

The development of HOTS enables postgraduate students to make significant contributions to the achievement of the Sustainable Development Goals (SDGs). In this respect, the conceptual framework identifies three key goals to

be achieved by postgraduate students in Sokoto State University. They include SDG 4—Quality Education—through improved learning outcomes, SDG 9—Industry, Innovation, and Infrastructure—through innovation and research competencies, and SDG 16—Peace, Justice, and Strong Institutions—through critical thinking. In this respect, the conceptual framework asserts that advancing postgraduate education in Nigeria requires the development of the identified predictors to build intellectual capacities that drive development in the region.

Cognitive dispositions

Cognitive dispositions, on the other hand, are long-term cognitive inclinations or intellectual traits that lead learners to solve problems in a certain way (inquisitiveness, open-mindedness, intellectual perseverance, reflection, etc.). Cognitive dispositions, according to theory, are not the same as cognitive skills, as they lead learners to use cognitive skills when the situation demands it, thus helping learners to develop HOTS (Facione, 2015). In addition, studies have shown that learners who exhibit high cognitive dispositions, such as intellectual curiosity, open-mindedness, and search for truth, are more likely to exhibit analytical thinking, self-directed study, and reflective thinking, which are linked to high HOTS (Facione et al., 1994; Facione, 2015). In the case of postgraduate students, cognitive dispositions provide the motivational and metacognitive foundation for learners to successfully take on research challenges and innovate, hence the importance of cognitive dispositions as a predictor of HOTS.

Cognitive dispositions are long-term mental predispositions that affect an individual's approach to learning and problem-solving. They comprise curiosity, open-mindedness, intellectual perseverance, and reflective judgment (Facione, 2015). Research evidence points to the fact that cognitive dispositions are significant in determining the likelihood that learners may participate in higher-order cognitive activities. This is in the sense that cognitive dispositions determine the likelihood that learners may apply critical thinking skills to address complex situations (Facione et al., 1994). For instance, a learner whose cognitive disposition favors curiosity may be more likely to ask inquisitive questions and make connections between concepts. Such an approach may be advantageous in the analysis, evaluation, and synthesis aspects of Bloom's taxonomy of cognitive abilities (Anderson & Krathwohl, 2001). Empirical evidence also points to the fact that cognitive

dispositions are significant in determining postgraduate learners' success. This is in the sense that cognitive dispositions may provide support to learners in persisting with research challenges. Research evidence from higher learning settings points to the fact that postgraduate learners whose cognitive dispositions favor truth-seeking and systematicity may be better placed to persist through the challenges associated with writing theses and engaging in original research activities (Yusuf & Alabi, 2020). In Nigeria, cognitive dispositions may provide postgraduate learners with intrinsic motivation to persist through the challenges associated with limited learning resources. Thus, cognitive dispositions are significant in determining HOTS in postgraduate learners at Sokoto State University.

Innovation Capacity

Innovation capacity in higher education has been defined as the capacity for generating, as well as implementing, innovative ideas or solutions in a higher education context (Dyer et al., 2009; Tierney & Lanford, 2016). Research on innovation capacity in higher education has highlighted the importance of culture (openness, collaboration), teaching practices (problem-based teaching, project-based teaching), and innovators' skills (idea generation, experimentation) as critical factors (ResearchGate literature on innovation capacity; Dyer et al., 2009). Higher innovation capacity in postgraduate education has been associated with a higher tendency for students to move beyond problem-solving into innovative creation, which aligns with the "create" dimension of Bloom's Taxonomy of Cognitive Abilities. Recent studies on innovation capacity in universities that focused on the development of a model for innovation capacity scales in higher education settings revealed that interventions in teaching that focused on innovation capacity training resulted in increased creative output in students and higher-order thinking skills (Tierney & Lanford, 2016; Rocha, et al., 2023).

Innovation capacity has been defined as the capacity for generating and implementing innovative ideas that create value (Dyer et al., 2009). In the context of higher education for postgraduates, innovation capacity has been defined as the capacity for integrating creativity and knowledge for the solution of academic, industrial, and societal problems. As such, innovative thinking requires cognitive flexibility, divergent thinking, and risk-taking behaviors that are all closely associated with higher cognitive processes such as evaluation and creation (Ovbiagbonhia et al., 2020).

Empirical evidence points to the fact that innovation-oriented learning environments promote graduates who are better equipped to develop innovative and creative responses to critical challenges in society (Dyer et al., 2019). In the case of postgraduate learners at Sokoto State University, there is a need to build the innovation capacity in line with the achievement of the SDGs, especially Goal 9, which focuses on Industry, Innovation, and Infrastructure. The research-oriented approach to creativity and application enables learners to develop HOTS and innovative responses to regional development challenges in Northwestern Nigeria.

Research Competencies

Research competencies, in the form of methodological knowledge, data analysis literacy, academic writing, and literature synthesis, have been found to be critical in postgraduate education and have been repeatedly found to be associated with higher-order cognitive abilities. In order to become proficient in research, one has to engage in analysis (breaking down complex problems into parts), evaluation (judging the evidence and methods), and synthesis (generating new knowledge), all of which fall within the domain of HOTS (Anderson & Krathwohl, 2001). In short, research competencies have been found to function both as instruments and vehicles for exercising HOTS, and therefore, stronger research competencies would lead to higher HOTS performance in postgraduates.

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Critical Thinking

Critical thinking, which has been described as “reasonable reflective thinking focused on deciding what to believe or do” (Ennis, 2018), has been widely

recognized as a primary antecedent of HOTS. Research literature has highlighted two aspects of critical thinking: disposition to think critically and cognitive processes involved in critical thinking (Facione, 2015; Ennis, 2018). Programmed interventions aimed at teaching argument analysis, evidence evaluation, and inference development have been found to enhance students' performance in tasks involving analysis and evaluation (Facione, 2015; Ennis, 2018). In postgraduate studies, critical thinking training through seminars, journal clubs, and research supervision has been found to correlate with enhanced quality of thesis work, more stringent methodology, and increased ability to critique and generate theories—clear manifestations of HOTS. Critical thinking, therefore, emerges as one of the strongest antecedents of HOTS from a conceptual as well as an empirical perspective (Kim & Choi, 2025 McGuire & Johnstone, 2023; Şahin & Yıldırım, 2023).

Critical thinking refers to a disciplined reflective process of analysis, evaluation, and judgment (Ennis, 2018). It has been recognized as one of the primary antecedents of HOTS since a long time. This is because critical thinking enables learners to think beyond mere memorization of facts and engage in logical thinking. In postgraduate studies, critical thinking enables students to critique existing theories, question assumptions, and generate logical arguments in their theses or research papers. Research literature has consistently demonstrated that students possessing a high level of critical thinking skills perform better in postgraduate studies since they are more capable of evaluating the validity and reliability of information (Walsh et al., 2019; Aydin & Aybek, 2024; Wei & Chen, 2024).

Apart from academic success, critical thinking skills will enable postgraduate learners to acquire lifelong skills that are immediately applicable to the accomplishment of the SDGs, specifically SDG16, Peace, Justice, and Strong Institutions. Critical thinkers are more likely to develop evidence-based decision-making skills, which are crucial to the establishment and maintenance of strong institutions and effective governance. In Northwestern Nigeria, higher education is key to regional transformation; hence, promoting critical thinking skills in postgraduates will ensure that graduates are able to address the region's socio-economic challenges. Critical thinking is, therefore, both a predictor and a promoter of HOTS and sustainable development.

Problem-Solving Skills

Problem-solving skills involve the capacity to recognize, depict, and solve complicated and, in many instances, ill-structured problems. Instructional designs that teach schemas, as well as problem-solving strategies and heuristics, are effective in promoting learners' HOTS, including apply, analyze, and create (Jonassen, 2014). Jonassen, et al., emphasize the importance of designing learning environments that offer authentic problems, as well as strategies and procedures, to learners as a means to develop their problem-solving skills. Research evidence from higher education institutions indicates that problem-based learning and scaffolded work with cases are effective in improving learners' analytic complexity and transfer of learning to novel contexts, which are both significant indicators of HOTS. Problem-solving skills are significant in the context of postgraduate learners, as they are able to frame their research problems creatively and develop viable and evidence-based solutions.

Problem-solving skills involve identifying, analyzing, and resolving complex or ill-structured problems in a systematic manner. Unlike other problem-solving skills, postgraduate problem-solving skills involve integrating knowledge with application, which directly engages higher-order cognitive processes (Jonassen, 2014). Problem-solving skills involve not just getting answers, but also defining problems, evaluating various solutions, and justifying solutions, which are located in the highest level of Bloom's taxonomy, namely, analysis, evaluation, and creation.

Research has shown that problem-based learning environments enhance students' HOTS significantly, enabling them to solve real-world problems (Jonassen, 2014). Problem-solving skills are crucial for postgraduate students of Sokoto State University in Nigeria to solve Nigeria's development challenges in education, governance, and innovation. Problem-solving skills are aligned with SDG 4 and SDG 9, enabling students to solve problems in creative and sustainable ways in education and infrastructure development. Problem-solving skills, therefore, are not just predicting HOTS, but also ensuring that postgraduate research is contributing to regional and global development priorities.

In a nutshell, therefore, from the literature, it is evident that cognitive dispositions provide motivational and metacognitive soil in which skills are developed, research competencies and problem-solving skills provide

methodological tools and practice contexts, innovation capacity provides generative and creative orientation, and critical thinking provides evaluative processes that inform sound judgment. All of these domains of variables have been researched, and they have all been found to be linked to Bloom's higher-order cognitive processes, namely, analysis, evaluation, and creation. Thus, measuring this set of predictors in a postgraduate sample is theoretically sound and likely to yield useful insights into which of them is likely to forecast HOTS most strongly, knowledge that might inform curriculum design, supervision, and SDG-oriented graduate training in Nigeria.

Methodology

Research Design

This study employed a quantitative correlational research design to investigate the predictive role of cognitive dispositions, innovation capacity, research competencies, critical thinking ability, and problem-solving skills in predicting higher-order thinking among postgraduate students at Sokoto State University. The correlational research design was considered appropriate for the study to investigate the relationship between variables and the predictive role of independent variables in predicting dependent variables. This type of research design was considered appropriate for the study as it aimed to measure the degree to which the variables predict HOTS.

Population and Sample

The target population for the study comprised all postgraduate students at Sokoto State University during the 2024/2025 and 2025/2026 academic sessions respectively. The population of study comprised all postgraduate students from various four faculties namely: Arts, Education, Management Science and Science. The required sample for the study was determined to be 201 postgraduate students at Sokoto State University through the Krejcie and Morgan table (Krejcie & Morgan, 1970). Stratified random sampling was employed to select participants for the study. This type of sampling was considered appropriate for the study as it increased the generalizability of the results as literature contend (Etikan & Bala, 2017; Creswell & Creswell, 2018). Stratified random sampling increases the generalizability of results as it includes participants from various Faculties and departments.

Instruments for Data Collection

Data collection was done through a structured questionnaire consisting of six sections. The first five sections were used to collect data from the independent variables. Firstly, cognitive disposition was measured using a modified version of the California Critical Thinking Disposition Inventory developed by Facione et al. (1994). Secondly, innovation capacity was measured using a modified version of the Innovator's DNA framework developed by Dyer et al., (2009). Thirdly, research competencies were measured using a postgraduate research skills inventory developed by Levy & Ellis (2011). Fourthly, critical thinking was measured using a modified version of Ennis's (2018) Critical Thinking Assessment Framework. Lastly, problem-solving skills were measured using a modified version of Jonassen's (2014) Problem-Solving Skills Scale. The sixth section measured the dependent variable: Higher-Order Thinking Skills, which was measured using a version of Bloom's Revised Taxonomy: analysis, evaluation, and creation (Anderson & Krathwohl, 2001). Respondents' feedback was measured on a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree.

Validity and Reliability of Instruments

Content validity was ensured by seeking feedback from three experts in educational measurement and curriculum studies from Sokoto State University. Construct validity was ensured by carrying out a factor analysis on the pilot questionnaires. This was done to confirm whether the factors were appropriately loaded. Finally, reliability was ensured by carrying out a pilot study involving 30 postgraduate students. This was done to confirm whether the internal consistency was within an acceptable range. This was done since literature contends that a range of 0.78 to 0.89 falls within an acceptable range (Tavakol & Dennick, 2011).

Procedure for Data Collection

Permission to carry out the research was sought from the School of Postgraduate Studies at Sokoto State University. A structured questionnaire was used. This was done to ensure a high response rate since respondents were assisted by trained research assistants. This was done to ensure a high response rate. Confidentiality was assured, and participants' consent was sought before data collection. Questionnaires were retrieved immediately after respondents completed them.

Method of Data Analysis

The data was analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics such as means and standard deviations were utilized to analyze the data. Pearson's Product-Moment Correlation was utilized to examine the relationships between predictors and HOTS. Multiple regression analysis was utilized to examine the predictive power of cognitive dispositions, innovation capacity, research competencies, critical thinking, and problem-solving skills in predicting HOTS (Field, 2018).

Results

This section presents the findings of the multiple regression analysis utilized to examine the extent to which cognitive dispositions, innovation capacity, research competencies, critical thinking, and problem-solving skills predict higher-order thinking skills (HOTS). This section is presented in accordance with standard statistical practices, with focus on the multiple correlation coefficient (R), coefficient of determination (R^2), adjusted R^2 , F-ratio, and significance level (p-value). Table 1 shows descriptive statistics with a focus on mean scores and standard deviations of study variables.

The findings show that postgraduate students scored high in critical thinking and research competencies, while cognitive dispositions and innovation capacity scored moderately in relation to HOTS. This implies that postgraduate students scored high in critical thinking and research competencies, while cognitive dispositions and innovation capacity scored moderately in relation to HOTS.

Inferentially, this implies that all variables scored above the midpoint of a scale, suggesting that postgraduate students demonstrated moderate to high cognitive dispositions, innovation capacity, research competencies, critical thinking, problem-solving skills, and higher-order thinking skills. Among the variables, critical thinking scored the highest, while cognitive dispositions scored the lowest in relation to postgraduate students. Table 1 shows Descriptive Statistics of Study Variables (N = 291).

Table 1: Descriptive Statistics of Study Variables (N = 291)

Variable	Mean (M)	Std. Deviation (SD)
Cognitive Dispositions	3.42	0.71
Innovation Capacity	3.58	0.68
Research Competencies	3.89	0.64
Critical Thinking	3.95	0.62
Problem-Solving Skills	3.77	0.66
Higher-Order Thinking	3.85	0.60

Source: Data Output from Statistical Package for Social Sciences (SPSS) version 26. (2026)

Table 1 presents the descriptive statistics of the study variables based on a sample size of 291 respondents. Overall, the results indicate that all variables recorded relatively high mean scores, suggesting generally strong levels of the constructs measured among participants.

Among the variables, Critical Thinking had the highest mean score ($M = 3.95$, $SD = 0.62$), followed closely by Research Competencies ($M = 3.89$, $SD = 0.64$) and Higher-Order Thinking ($M = 3.85$, $SD = 0.60$). This suggests that respondents demonstrated comparatively stronger abilities in analytical reasoning, research-related skills, and advanced cognitive processing.

Problem-Solving Skills also showed a high mean score ($M = 3.77$, $SD = 0.66$), indicating a relatively strong capacity to identify and address complex problems. Similarly, Innovation Capacity ($M = 3.58$, $SD = 0.68$) and Cognitive Dispositions ($M = 3.42$, $SD = 0.71$) recorded moderately high mean values, though they are slightly lower than the other constructs.

In terms of variability, the standard deviations across all variables are relatively low (ranging from 0.60 to 0.71), indicating a moderate level of consistency in respondents' perceptions and responses. Overall, the descriptive results suggest that while all constructs are positively rated, higher-order cognitive and research-related competencies are more pronounced than foundational cognitive dispositions and innovation capacity.

Furthermore, Pearson correlation coefficients were also computed to examine the relationship between the predictors and higher order thinking skills (HOTS). Table 2 shows that all the predictors have positive and significant correlations with HOTS. Critical thinking has the highest positive correlation with HOTS, followed by research competencies. The correlation matrix revealed that all the predictors have positive and significant correlations with higher order thinking skills (HOTS), with correlation coefficients ranging

from .51 to .61. Among the predictors, critical thinking has the highest positive correlation with HOTS, while cognitive dispositions have the lowest positive correlation with HOTS. Table 2 shows the results of the correlation matrix.

Table 2: Correlation Matrix of Predictors and HOTS

Variable	1	2	3	4	5	6
1. Cognitive Dispositions	1					
2. Innovation Capacity	.42**	1				
3. Research Competencies	.47**	.49**	1			
4. Critical Thinking	.44**	.46**	.52**	1		
5. Problem-Solving Skills	.41**	.43**	.48**	.55**	1	
6. Higher-Order Thinking	.51**	.53**	.59**	.61**	.57**	1

Source: Data Output from Statistical Package for Social Sciences (SPSS) version 26. (2026)

Furthermore, a multiple regression analysis was conducted to examine the predictive role of the independent variables in explaining higher order thinking skills (HOTS). Table 3 shows that the results of the multiple regression analysis revealed that the model has significant predictive role in explaining higher order thinking skills (HOTS). Furthermore, the results revealed that all the five predictors have significant roles in explaining higher order thinking skills (HOTS). Among the five predictors, critical thinking has the highest positive regression coefficient, followed by research competencies and problem-solving skills. On the other hand, cognitive dispositions and innovation capacity have smaller positive regression coefficients. Table 3 shows the results of the multiple regression analysis.

Table 3: Multiple Regression Predicting HOTS from Independent Variables

Predictor	β (Beta)	T	Sig. (p)
Cognitive Dispositions	.19	3.42	.001
Innovation Capacity	.15	2.98	.003
Research Competencies	.24	4.85	.000
Critical Thinking	.28	5.71	.000
Problem-Solving Skills	.21	4.12	.000

Source: Data Output from Statistical Package for Social Sciences (SPSS) version 26. (2026)

The model summary indicates that the five predictors: Cognitive Dispositions, Innovation Capacity, Research Competencies, Critical Thinking and Problem-Solving Skills, combined, account for more than half (54%) of the variance in higher-order thinking skills, which is a significant proportion. Among these predictors, critical thinking skills emerged as the most significant predictor of

higher-order thinking skills in the classroom, followed by research competencies and problem-solving skills, while cognitive dispositions and innovation capacity are also significant predictors but slightly lower in value. The high value of F and significant value of p confirm that the model is reliable and statistically sound. The summary of findings is as follows:

- I. The multiple regression model is statistically significant and accounts for 54% of the variance in higher-order thinking skills (HOTS) ($R = .74$, $R^2 = .54$, Adjusted $R^2 = .53$, $F = 42.73$, $p < .001$).
- II. All five predictors: Cognitive Dispositions, Innovation Capacity, Research Competencies, Critical Thinking, and Problem-Solving Skills are significant predictors of higher-order thinking skills.
- III. The predictor critical thinking skills emerged as the most significant predictor of higher-order thinking skills in the classroom ($\beta = .28$, $p < .001$), emphasizing its importance in enhancing higher-order thinking skills in students.
- IV. The predictors research competencies ($\beta = .24$, $p < .001$) and problem-solving skills ($\beta = .21$, $p < .001$) also emerged as significant predictors of higher-order thinking skills in the classroom.
- V. Cognitive dispositions (.19, $p = .001$) and innovation capacity (.15, $p = .003$) were significant, although to a lesser degree compared to the other variables.
- VI. Similarly, correlation analysis revealed that all the predictors were significantly, if moderately to strongly, correlated with HOTS. Critical thinking was found to have the strongest correlation with HOTS ($r = .61$), whereas cognitive dispositions were found to have the weakest correlation but still a significant one ($r = .51$).

Discussion

The findings of this study confirm that cognitive dispositions, innovation capacity, research competencies, critical thinking, and problem-solving skills are significant predictors of HOTS among postgraduate students of Sokoto State University. This finding supports the perspectives offered by Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001) and constructivist learning

theory (Piaget, 1972; Vygotsky, 1978) on the role of cognitive processes in achieving HOTS. Moreover, the findings of this study are consistent with more recent empirical studies suggesting that HOTS are not just a product of teaching strategies but are significantly influenced by learners' internal dispositions and skillsets (Brookhart, 2010; Zohar & Dori, 2012). This points to the need to develop more teaching models centered on metacognition, self-regulation, and reflection, which play a mediating role between learners' dispositions and HOTS.

Moreso, critical thinking was found to be the strongest predictor of HOTS, reinforcing previous research that analytical thinking and reflective judgment are crucial in postgraduate education (Ennis, 2018). This implies that students with the ability to analyze evidence and think critically about their assumptions are likely to succeed in tasks that require analysis and creative thinking. Furthermore, research competencies had a significant influence on HOTS, consistent with Levy and Ellis (2011), who posit that research competencies improve students' ability to generate new knowledge and apply it in problem-solving. This is in line with more recent research that recognizes critical thinking and research competencies as complementary forces in knowledge production and innovation in higher education (Bezanilla et al., 2019; Ku et al., 2021). This implies that postgraduate programs must incorporate critical inquiry and research competencies to enhance students' ability to think independently and make informed decisions.

Problem-solving skills also had a significant influence on HOTS, reinforcing Jonassen's (2014) argument that problem-solving activities help students to think cognitively and go beyond mere memorization of knowledge. Furthermore, cognitive dispositions such as curiosity and open-mindedness had a positive influence on HOTS, consistent with Facione et al. (1994), who highlight the significance of dispositions in sustaining intellectual inquiry in students. Innovation capacity was also found to have a significant effect on HOTS, consistent with Dyer et al. (2009), who highlight the significance of creative and innovative thinking in knowledge application in real-world contexts. More recent research reinforces the interconnectedness of problem-solving, dispositions, and innovation in enhancing students' ability to think cognitively and creatively, such that engagement with ill-structured problems enhances both cognitive flexibility and creative thinking (Mumford et al., 2012; Kim & Choi, 2025). This implies that developing HOTS in students is

more than merely teaching knowledge in a learning environment; it requires an environment that is likely to enhance students' ability to experiment, think flexibly, and creatively.

Overall, these results imply that HOTS among postgraduate students are multidimensionally influenced and can be enhanced through teaching and curriculum development. Significantly, by promoting HOTS, higher learning institutions can effectively prepare their students to contribute to the achievement of the Sustainable Development Goals (SDGs) in quality education (SDG 4), innovation (SDG 9), and strengthening institutions (SDG 16) in Nigeria and beyond. The general implication of this study is that higher learning in general needs to focus on the integration of cognitive, affective, and skill-based domains in instructional design (Halpern, 2014; Trilling & Fadel, 2009). By promoting HOTS in higher learning, not only can we improve individual learning outcomes but also contribute to societal development in terms of promoting innovation, good governance, and sustainability.

Implications of the Study

The implications of this study are that there is a need to design a postgraduate curriculum in Sokoto State University and other similar institutions in such a manner that higher-order thinking is enhanced by incorporating critical thinking, research competencies, and problem-solving skills in the curriculum. This is because critical thinking and research competencies emerged as the strongest predictors of HOTS in this study. As such, there is a need to go beyond knowledge acquisition in teaching and learning to incorporate evaluative and creative activities, such as those in Bloom's Revised Taxonomy. Furthermore, the significance of cognitive dispositions implies that there is a need to design teaching strategies in such a manner that students are encouraged to be curious, intellectually open, and to think and reflect, among other qualities. As such, lecturers in postgraduate classes should employ learner-centered strategies such as problem-based learning, case studies, and debates, among others, to help students think and act in a critical and creative manner, so that they internalize dispositions that enhance their intellectual growth.

The predictive effect of research competencies implies that there is a need to enhance research competencies in postgraduate classes in Nigeria, so that students are better equipped to conduct quality research, which in turn

enhances their higher-order thinking skills. Innovation capacity, which emerged as a significant predictor of HOTS, implies that there is a need to incorporate innovation-driven activities in postgraduate classes in Nigeria, so that students are better equipped to enhance innovation in Nigeria, which in turn enhances national development.

The role of problem-solving as a mediator implies that education should focus more on real-life problems that require critical thinking and creativity. This study has practical implications if postgraduate training guidelines in Nigeria are revised based on the findings. HOTS competencies should be strengthened as key graduate attributes. By ensuring that postgraduate training guidelines require alignment to critical thinking, research, and innovation, Nigeria's higher education policies can position universities to compete globally. This study has practical implications for Nigeria's contribution to achieving the SDGs. HOTS competencies can be leveraged to drive SDG 4: Quality Education, through innovation in education; SDG 9: Industry, Innovation, and Infrastructure, through research-based innovation; and SDG 16: Strong Institutions, through informed decision-making. This emphasizes the role of postgraduate training in achieving sustainable development.

This study emphasizes the need for institutions to provide support to students in developing HOTS competencies. Without such support, students may not be able to apply cognitive skills to practice. This may hinder students from contributing to development. Universities need to provide students with support such as research grants, access to virtual libraries, and innovation hubs to develop HOTS competencies.

In a knowledge-driven economy, higher-order thinking skills provide the predictors for global competitiveness among university graduates. By encouraging the development of these predictors, Nigerian universities can improve the chances of their products for successful participation in the global academic and professional communities. This suggests that universities like Sokoto State University need to adopt a global perspective in the design of their academic programs. Finally, the study highlights the importance of postgraduate education for the cultivation of lifelong learning dispositions. The cognitive dispositions and problem-solving skills of university graduates go beyond academic success to influence their lifelong growth and development. The cultivation of these dispositions and skills in university

graduates is essential for their ability to cope with future challenges and for national development.

Limitations of the Study

Although the study has offered significant insights into the subject, there are limitations to this study that need to be addressed.

Firstly, the study has been conducted on the population of postgraduate students in Sokoto State University; hence, the study cannot be generalized to other universities in Nigeria or in other countries.

Secondly, the study has been conducted using a cross-sectional research design; hence, the study has not been able to take into account the changes in the cognitive dispositions of the students, research skills of the students, and critical thinking skills of the students in Nigeria or in other countries.

Thirdly, the study has been conducted using self-report measures; hence, there is a possibility that the study might be influenced by a response bias in which the participants might overreport or underreport their skills and dispositions.

Moreover, although the study has focused on some of the significant predictors of innovation capacity, critical thinking skills, research skills of the students in Nigeria or in other countries, cognitive dispositions of the students in Nigeria or in other countries, problem-solving skills of the students in Nigeria or in other countries, there are other factors that might be significant in predicting the innovation capacity of the students in Nigeria or in other countries.

Lastly, the study has focused on the predictive relationship rather than a causative relationship; hence, even though the study has established significant predictive relationships between the variables, there is no way of ascertaining that these factors actually improve the innovation capacity of the students in Nigeria or in other countries.

Future Directions of the Study

Guided by the results and discussions in the study, the following are the proposed directions for future research to further enrich the knowledge on higher-order thinking skills (HOTS) for postgraduate students.

Firstly, it is proposed that future research employs longitudinal research designs to investigate the cognitive dispositions, critical thinking skills, research abilities, innovativeness, and problem-solving skills in postgraduate students. This research approach would offer more profound and robust insights into the dynamic and developmental nature of HOTS. Moreover, longitudinal research would allow researchers to investigate cause-and-effect relationships rather than predictive relationships.

Secondly, there is an urgent need to undertake comparative studies in various universities and regions within and outside Nigeria. This would enrich the study by enhancing the generalizability of the results. It would also reveal the role of contextual variables in the development of HOTS in postgraduate students.

Hence, it is proposed that future research employs mixed-methods research designs by combining quantitative data collection methods with qualitative methods. This approach would offer more profound and nuanced insights into the development of HOTS in postgraduate students. More specifically, mixed-methods research would reveal why critical thinking and research skills emerge as significant predictors of HOTS in postgraduate students.

Furthermore, experimental and quasi-experimental research designs are proposed to investigate the effectiveness of strategies to develop HOTS in postgraduate students. For instance, researchers could investigate the effectiveness of metacognitive strategies, inquiry-based learning, problem-based learning, and research-integrated curricula in enhancing HOTS in postgraduate students.

Further research into the following variables not covered in the present study may also be useful: digital literacy, socio-economic factors, learning technologies, emotional intelligence, and support systems. This will help construct a more comprehensive model for the development of HOTS in higher education.

Finally, future research may focus on the association between the development of HOTS and societal outcomes in the context of sustainable development goals (SDGs). This includes an exploration of the role of enhanced HOTS abilities in postgraduate students for the development of innovations and sustainable problem-solving in the real world.

Conclusion and Recommendations

This study was designed to examine the predictive influence of cognitive dispositions, innovation capacity, research competencies, critical thinking, and problem-solving skills on the development of higher-order thinking (HOTS) abilities among postgraduate students of Sokoto State University in Nigeria. The findings of the study revealed that all five predictors had a significant and positive influence on the development of higher-order thinking (HOTS) abilities among the participants. Critical thinking and research competencies emerged as the strongest predictors of the development of higher-order thinking (HOTS) abilities among postgraduate students of Sokoto State University in Nigeria. The findings of the study underscore the multi-dimensional nature of higher-order thinking (HOTS) abilities and the need for the inclusion of higher-order learning strategies in postgraduate education. The study also underscores the fact that the development of higher-order cognitive abilities is not only an academic necessity but also a developmental necessity for the future of Nigeria and the Nigerian people. The study concludes that higher-order cognitive abilities in postgraduate students will not only contribute to the academic development of Nigeria but also help the country achieve the sustainable development goals (SDGs) and become a competitive member of the global community. Fostering higher-order cognitive abilities in postgraduate students will not only help Nigeria become a competitive member of the global community but also help the country become a beacon of hope for the future and a source of sustainable development for generations to come. On the basis of the findings of the present study, the following recommendations are made:

- I. Postgraduate curricula should be reviewed to include more emphasis on developing higher-order thinking skills through the inclusion of critical thinking, research, and problem-solving exercises.
- II. Lecturers should use learner-centered approaches like problem-based learning, case studies, debates, and projects to promote critical thinking and creativity.
- III. Universities should provide workshops to enhance the research skills of postgraduate students in design, data analysis, and academic writing.

- IV. Universities should establish innovation hubs, incubation centers, and research platforms to promote innovation and entrepreneurial thinking in students.
- V. Assignments and assessments should be based on actual problems, allowing students to apply their cognitive skills to solve actual problems in society and national development.
- VI. Higher education policy in Nigeria should be designed to include higher-order thinking skills as graduate attributes to ensure uniformity and quality.
- VII. Universities should prioritize the provision of digital libraries, international journals, research grants, and other learning technologies to enhance cognitive skills.
- VIII. Postgraduate education should include a connection to the SDGs to ensure students understand the importance of cognitive skills to national and international development.

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