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Learning Styles and Critical Thinking among Undergraduates of University of Port Harcourt

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study was based on the prediction of critical thinking using learning styles. It was guided by two research questions and two null hypotheses. A sample of 393 third years undergraduates selected from four faculties in the University of Port Harcourt, Rivers State, Nigeria was used for the study. Data was collected from two adopted instruments tagged Cornell Critical Thinking Test (CCTT) Level Z and the Learning Style Questionnaire (LSQ). The face validation of the two instruments was conducted by three experts in Measurement and Evaluation. Reliability analysis of the CCTT using Kuder-Richardson 20 yielded a coefficient of 0.81, while the LSQ had a split-half coefficient of 0.77. Data were analyzed using stepwise multiple regression analysis. Result obtained indicated that pragmatist and reflector learning styles were significant predictors of critical thinking while theorist and activist were not significant predictors. Based on these results, appropriate recommendations and conclusions were drawn.

Keywords: Critical thinking; learning styles pragmatists; activists; theorist; reflector.

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1. INTRODUCTION

University is an institution where individuals acquire self-confidence, self-respect and self-dependencies. It is also a place where individuals are nurtured on how to generate new ideas and discard the ones that will retard the growth of self and that of the nation. Again university helps students to imbibe good aspects of their culture and to accept new values for all-round development. To support this Fortino [1] asserted that higher education aims to develop prepared minds in science, research, management, engineering as well as businesses. A prepared entrepreneurial mind converts the innovations created by engineers, scientist and others into economic prosperity.

West [2] reported that a university is not a place where students just acquire mere knowledge but it is a place where students acquire the underpinning knowledge that is then applied practically in different contexts. That is the students are not just nurtured to be absorbers of knowledge but also on how to be creative, complex problem-solvers, entrepreneurial-oriented, critical thinkers, emotionally intelligent, decision-makers, flexible in mind and adaptable for work.

To succeed in all these, the students need to move away from mere thinking that comes on its own, to the rational and scientific way of thinking which is critical thinking.Critical thinking is the foundational skill for 21st-century success [3]. To Halpern [4] critical thinking has been singled out as one of the most important skills for citizens of the twenty-first century to survive. This may be necessary due to the following: firstly the twenty-first century is a period that needs effective problem solvers, decision-makers, and creative thinkers. As a result, universities are moving away from teaching purely functional skills that are outdated almost as soon as they are learned to focus on real-world learning experience that allow them to be adaptable, enterprising and ready for work [2]. Secondly, our society is a high global knowledge economy that is fast driven by information and technology. To survive in such an economy one needs the appropriate skills and mindset that allow one to deal with changes quickly and effectively. Demirhen, Besoluk, and Onder [5] stated that in the tech-global knowledge economy only graduates with the appropriate skills and mindset can compete. In line with this, Islam [6] stated that the new knowledge economy requires individual with flexible intellectual skills and abilities to analyse information by thinking well and solving problems effectively. Such thinking skills are enhanced by good critical thinking.

The third reason, technology depends so much on science and mathematics, which requires the critical use of reasoning to carry out experiments, calculation and to confirm theories. However, to some extent, critical thinking is the foundation of science [6].

Fourthly, we are in a democratic society which functions properly with citizens who can think critically about social issues to overcome biases and prejudice that manifest so much in a democratic society. Critical thinking skills help one to better understand the experiences and views of others, enhancing one's ability to work with different people. It helps one to effectively use emotional appeal, letting ones feeling to influence the reasoning by Islam [6]. So minds not prepared cannot fit in properly.

Moreso critical thinking relates to all tasks, discipline, topics and life challenges. It is not a thinking skill that is solely for one discipline or subject area alone but it applies to all areas of life activities such as education, research, business, finance, medicine, management, politics, the legal profession and so on. To crown it, Islam [6] viewed critical thinking as a domain-general skill while Huang [7] viewed it as a necessary ability required for all students to do well in the universities irrespective of their disciplines. To the researcher, critical thinking is the ability to think very clearly, rationally, scientifically and adequately in almost every life situation.

All these assertions boil down to the importance of critical thinking to the development of self and society. Critical thinking is the ability of an individual to analyse the way he/she thinks and present evidence for one's ideas [6]. It is a process that enables students to make an informed decision about conflicting claims [8]. Critical thinking is a reflective way of thinking that is focused on helping one carrying out the right decision.

Furthermore, it is a skill that helps to promote self-directed,self-awareness, self-disciplined, self-monitored and self-corrective thinking thereby producing independent learners. Independent learners are geared towards self-reliant individuals. Critical thinking is a skill that

allows learners to assess the adequacy of the information they obtained. In other words, a good critical thinker does not just accept information they obtained irrespective of the source but will first examine the information from all sides to enable him/her to filter the information by separating the facts from opinions.

Good critical thinkers are very curious and reflective. They always like to explore and probe new areas to obtain deeper knowledge, good clarification and new solutions to a given task. They ask pertinent questions, evaluate statements and arguments. To Martlin (2004) critical thinking requires:

- Students to ask good questions about what they see or hear.
- Determine whether the conclusion flowed from the evidence that was presented.
- Suggest a better alternative to the interpretation already made.

Furthermore, good critical thinkers are very skeptical and enthusiastic, they like to ask probe questions like "How do you know that the information is adequate' how true is this" on this note they do not simply memorize facts or blindly accept what they hear or read but will analyse the information with a high level of skepticism. Sequel to this Woolfolk, Hughes and walkup (2008) asserted that critical thinking skills entail defining and clarifying the problem, making judgments about the consistency and adequacy of information related to a problem and drawing conclusion. Islam [6], viewed critical thinking as a very important skill for the enhancement of creative language and presentation skills as well as academic performance.

Besides Kavanaugh [9] stated that the lack of good critical thinking leads to failure in employment interviews, delayed promotion and stagnation in career among young professionals. Moreso, Donaldson [10] reported that critical thinking is a better predictor of high events of life than intelligent quotients.

In all, as important as critical thinking it was observed,virtually everyone agrees that a primary yet insufficiently met, the goal of schooling is to enable students to think critically. Willingham [11] reported thatmore than 40% of the students could not draw inferences from written materials and only 20% could write a persuasive essay. Again, that some students enter the universities with poor critical thinking skills. This is evidence in the diversities in their academic performance and the presentation skills of students mostly those in the University of Port Harcourt. Meanwhile, it was asserted that good critical thinking promotes good presentation skill and academic achievement [6]. Arum and Roksa [12] and Fisher [13] reported that students differ in their level of critical thinking, that iswhy some students have problems in their critical thinking, while some others do not. So at this point, the question is “why are there diversities in the students’ critical thinking? To answer this question, Huang [7] reported that diversities in the students' background may be a contributing factor to their different levels in critical thinking. There are three categories of diversities that significantly influence teaching and learning of students, these include the students learning styles, approaches to learning and intellectual development levels [14].

To this end, the question now is;does diversity in students’ learning styles contribute to their different levels in critical thinking? An attempt to answer this question necessitated this study on learning styles and critical thinking among undergraduates.

Learning styles are the identified ways of taking in and processing information [14]. Learning styles do not indicate what students learn but how they learn preferably. Some prefer to dealing with concrete information, experimental data or facts while some others prefer to deal with abstract data. Honey and Mumford (1992:1) viewed learning style is a description of the attitude and behaviour which determine an individual preferred way of learning. Kolb (2005) stated that the concept of learning styles describe individual differences in learning as a result of the individual preferences.

Gokalp [15] regards learning style as the characteristic, cognitive, affective and psychological behaviours that serve as a relatively stable indicator of how learners perceive, interact with and respond to a learning environment. Owing to this, the researchers viewed learning styles as the preferred pattern a learner desire to internalized and process information. Students preferred ways of learning differ from individual to individual. Rassool and Rawl [16] reported that reflector learning style was the dominant learning style among the majority of undergraduates nursing students.

Gokolp [15] also stated that learning style is a very influential factor in students’ attitude and

academic achievement. In another dimension, Yenice [17] reported a significant difference between the critical thinking of students with divergent learning styles and those with accommodator learning styles. In 2012, Nassrabadi [18] reported a significant influence of learning styles on students critical thinking. Specifically that students with converging learning style expressed the highest level of critical thinking followed by diverging, assimilating and then accommodating learning styles.

On the contrary, Mahmoud (2012) found no significant relationship between critical thinking and the learning styles of nursing students. However, Ghazivakili, Nia, Panahi, Karimi, Gholsorkhi, and Ahmadi [19] reported a significant mean difference on the critical thinking of students based on their learning styles. Precisely that students with convergent learning styles expressed the highest level of critical thinking followed by accommodator, divergent and then assimilator learning styles.

A critical observation on the past researches shows that none was conducted in Nigeria. Again that except one, all others used Kolb model of learning styles in the mixed of other models of learning styles such as Fleming VARK, Kolb learning style inventory, Honey-Mumford model Felder-Silverman model style, 4MAT model, Hermann Brain Dominant instrument (HBDO) and Howard Gardners theory of multiple intelligence and so on.It is against this hunch that the researchers were compelled to embark on this study which anchored on Honey and Mumford model of learning styles to predict students' critical thinking in the University of Port Harcourt.

There are four learning styles which are the activists, theorists, pragmatists, and reflectors. The activists are the learners who learn by doing. They like involving in learning activities such as brainstorming, problem-solving, group discussion, Puzzles, role-playing and competition and so on (Mobb, 2010). Theorists are learners who like to analyse and synthesis they are more involved in learning activities such as model, stories, statistics quotes and applying concepts and so on. Pragmatists are learners who learn by experimenting with new ideas, knowledge, speculations, theories to see if they are workable in real life. They learn better through careful thinking on how to apply acquired knowledge in real life activities, problem-solving and then discussion (Mobb, 2010).

Reflectors are learners who learn by carefully observing others and deeply think about what happened to get the adequacy of the information obtained obviously. Nevertheless, Honey and Mumford model of learning styles were developed based on the inspiration from the Kolb's learning styles model [20]. The different learning styles are stimulated by different learning activities. Honey and Mumford's model of learning styles is an alternative to Kolb's model of learning styles. Past studies reported that Kolb's model of learning styles influence critical thinking, on these bases the researcher presumed that Honey and Mumford learning styles may predict critical thinking among students.

So the study aims to predict the critical thinking of undergraduates at the University of Port Harcourt using Honey and Mumford model of learning styles. It is hoped that through the findings from the present study graduates with appropriate skills and mindset to compete in the challenges of the 21st century will be produced. Again, the findings from this study will increase the possibility of producing graduates with high employability skills. Islam [6] asserted that employers of labour are not only looking for employees with highly specialized academic skills but also for those with good thinking and communication skills like good critical thinkers. Through this study, the vision of many universities will be achieved especially that of the University of Port Harcourt whose vision is "to be ranked the best among universities in the world-renowned for teaching, research, innovation and knowledge transfer. This is possible because the acquisition of critical thinking promotes knowledge transfer via creativity. So if the students' learning styles are linked with their critical thinking there will be adjustment among students to adopt the appropriate learning styles.

To achieve the aim of this study, the following two research questions were raised:

1. How does the learning styles of activists, theorists, pragmatists and reflectors, jointly predict critical thinking among undergraduates?
2. What are the relative contributions of the activists, theorists, pragmatists and

reflectors learning styles on the prediction of critical thinking of undergraduates?

To further achieve the aim of the students the following two null hypotheses were postulated and tested at 0.05 alpha level

- Learning styles of activists, theorists, pragmatists and reflectors do not jointly predict critical thinking significantly among undergraduates.
- Learning styles of activists, theorists, pragmatists and reflectors do not independently, contribute significantly to the critical thinking of the undergraduates.

2. METHODS

The study took a correlation research design by multiple prediction approach. It was conducted using 400 level 300 students of University of Port Harcourt Rivers State, Nigeria. The sample was constituted using a two-stage sampling method. At stage one, four faculties out twelve (12) in the university were selected using simple random sampling by balloting method. At stage two, one hundred level 300 undergraduates were selected from each faculty chosen for the study. The faculties are faculty of education, sciences, management sciences and engineering using a purposive and accidental sampling technique. This is because only level 300 students available during the administration of the instrument were chosen until the required number was obtained. On the whole 400 students were selected for the study. For data collection, two instruments were used. They are Cornell Critical Thinking Test (CCTT) developed by Ennis, Millman and Tonko [21] and Learning Style Questionnaire (LSQ). The researcher made use of the Level Z of the CCTT because it was designed for advanced and gifted high school students, college students, graduate students and other adults. The instrument is made up of 52 items with 3 options (A, B and C) multiple-choice formats. It had 7 subscales that elicited information on the skills of induction, deduction, value judgement, observation, credibility, assumption, and meaning. However, the researchers made use of the overall score. The CCTT was dichotomously scored, hence the minimum and maximum score obtainable were 0 and 52.

The second instrument, the Learning Style Questionnaire was adopted from the learning styles questionnaire developed by Honey and Mumford (1986). It contains 80 items on the whole but 20 items on each section addressing a particular learning style. That is the test is made up of four sections based on the four types of learning styles as operationalized by Honey and Mumford (1986).

The four sections elicited information addressing activists, pragmatists, reflectors and theorists learning styles. The items statement were responded using agree (√) and disagree (x). An agree respond √ on any item attracts 1 mark while a disagree response (x) attracts 0 mark. Thus each section had a maximum of 20 marks and a minimum of zero (0) mark.

The face validity of the two instruments CCTT and LSQ were determined by the scrutiny of three experts in measurement and evaluation in terms of grammar suitability and brevity of the item in relation to the objectives of the study.

The internal consistency estimate obtained by the original authors ranged from 0.52 to 0.77 using Kuder Richardson Formula 20 (KR20). However, for the purpose of this study, the researchers were not interested in the sub-scales but the overall scale. Using the same method, the reliability coefficient obtained was 0.81 indicating that the instrument was highly reliable. The reliability of the second instrument (LSQ) was estimated using the split-half method. This yielded a coefficient of 0.77 indicating that the LSQ possesses high internal consistency level. So LSQ is also a reliable instrument for the study.

At the confirmation of the psychometric properties of the instruments, the copies of the two instruments were administered to the sampled 400 level 300 undergraduates via a direct delivery approach. Thereafter, the instruments were scored and collated for analysis.

The data collected were analyzed using multiple regression and other statistics associated with it such as analysis of variance, beta value (standardized partial regression coefficient) and t-values. However, it is worthy of note that during scoring and collation of data it was discovered that seven copies of the instrument representing 1.75% of the sample were invalidated. Thus the analysis was conducted using 393 scores representing 98.25% of the sample of each variable.

3. RESULTS

The result of research question 1 and its corresponding null hypothesis are presented

Table 1. Summary of multiple regression analysis on the prediction of critical thinking the joint influence of four learning styles

Model	R	R-square	Adjusted R^2	Standard error of the estimate
1	0.397	0.158	0.156	10.82
2	0.460	0.211	0.207	10.48

Table 2. Summary of analysis of variance associated with multiple regression on the prediction of critical thinking on the learning styles

Model	Source of variation	Sum of squares	Df	Mean square	F	P-value
1	Regression	8576.09	1	8576.09	73.27	0.000
	Residual	45764.46	391	117.05		
	Total	54340.55	392			
2	Regression	1476.62	2	5738.31	52.21	0.000
	Residual	42863.93	390	109.91		
	Total	54340.55	392			

Table 3. Relative contributions of the predictor (included) variables using the beta and their associated t-values

Model		Unstandardized coefficient		Standard coefficient		P-value
		B	Std error	Beta	T	
1	(constant)	17.033	2.537		6.713	0.000
	PLS	1.476	0.172	0.397	8.560	0.000
2	(constant)	3.291	3.593	-	0.994	0.321
	PLS	1.291	0.171	0.347	7.549	0.000
	RLS	1.391	0.271	0.236	5.137	0.000

Table 4. Relative contributions of the predictor (excluded) variables using beta and their associated t-values

Model		Beta in	T	Sig.	Partial correlation	Collinearity statistics tolerance
1	TLS	-.092[a]	-1.958	.051	-.099	.970
	ALS	-.047[a]	-1.006	.315	-.051	.967
	RLS	.236[a]	5.137	.000	.252	.955
2	TLS	-.087[b]	-1.913	.057	-.097	.969
	ALS	.011[b]	.225	.822	.011	.909

respectively in Tables 1 and 2 while that of research question 2 and its corresponding null hypothesis are presented together in the same Table 3.

In Table 1, it is revealed that for model 1, only pragmatist learning style was included while reflector, activists, and theorists learning styles were excluded. For that model, the multiple correlation coefficient (R) obtained was 0.397, coefficient of multiple determination (R^2) of 0.158 and the adjusted coefficient of multiple determination, (adjusted R^2) of 0.156 were also obtained. Based on the adjusted R^2, it was deduced that the inclusion of only pragmatist learning style at the exclusion of reflector, activist and theorists was only accountable for 15.6% variations in the students' critical thinking.

It was also revealed in model 2 of the table that reflector learning style was added to the model and this yielded a multiple correlation coefficient of 0.460, the coefficient of multiple determination (R^2) of 0.211, and adjusted coefficient of multiple determination of 0.207.Considering the adjusted R^2 for model 2, it was then deduced that the inclusion of pragmatist and reflector learning styles in the model jointly accounted for 20.7% of the changes in the level of the students' critical thinking. On the other hand, 79.3% of the students' changes in critical thinking are not explainable by the knowledge of the joint

influence of pragmatists and reflector learning styles. It is also deduced from model 2 that only two independent (predictor) variables met the criteria for inclusion in the model to predict critical thinking while the other variables such as activists and theorists learning styles did not.

Results displayed in Table 2 shows that F-value obtained for models 1 and 2 are 73.27 and 52.21 respectively, it was also shown that both values were obtained at the p-value of 0.0005 ($P<0.05$). Thus only pragmatist learning was the predictor variable that significantly predicted critical thinking among the other independent (prediction) variables in model 1.

Again as shown in model 2 of Table 2, pragmatist and reflector learning styles were the only independent variables that jointly predicted for critical thinking significantly among other independent variables such as activist and theorist learning styles that were not included in the model.

It is shown in Table 3 that in model 1 where only pragmatist learning styles was (included, the unstandardized regression coefficient (B) is 1.476 for pragmatist learning style while that of constant is 17.033. thus the simple linear predicting rule for critical thinking among students is $Y^1 = 17.033 + 1.476\ x$ where y is the predicted level of critical thinking, x is any score on pragmatist learning style.

It is also depicted in Table 2 that for model 2 where pragmatist and reflector learning styles were included, the unstandardised regression coefficient (B) obtained were 3.291 for constant, 1.291 and 1.391 for pragmatist and reflector learning styles respectively. Thus the multiple linear predicting rule is $Y^1 = 3.291 + 1.291\ x_1 + 1.391x_2$ where Y^1 is the predicted critical thinking score while x_1 and x_2 are scores on pragmatist and reflector learning styles respectively. Again in the model 2, the standardized regression coefficient (beta, value) obtained for the two included predictor variables are 0.347 and 0.236 respectively for pragmatist and reflector learning styles. Then their significant associated t-values were 7.55 and 5.14 ($P< 0.005$) respectively for pragmatist and reflector learning styles.

Furthermore, it is displayed in model 2 of Table 4 that two variables, activist and theorist learning styles were excluded from the model and their standardized regression coefficients (Beta, values) are -0.087 and 0.011 respectively for theorist and activists learning styles. Then their insignificant t-values are -1.913 and 0.225 ($P>0.05$) respectively for theorist and reflector learning styles. Hence they are insignificant predictors of critical thinking.

4. DISCUSSION

The results presented in Table 1 suggested that pragmatist learning style was the first and only variable (learning styles) that was included in the model. This indicated that pragmatist is the most influential predictor variable of critical thinking among the undergraduate. Second to pragmatist learning style is the reflector learning style which was added to the pragmatist learning style in model 2. That means among the learning styles of Honey and Mumford (1986) only two, pragmatist and reflector learning styles were significant predictors of critical thinking among the undergraduates. Their significant contributions in predicting learning styles were proven by the significant f-values and t-values obtained in Tables 2 and 3 respectively.

The significant contributions of the pragmatist and reflector learning styles are not surprising. This is due to the fact that the significant contribution of pragmatist may be traceable to the learning activities, the pragmatists like to be involved. The learning activities trigger not just mere thinking but the critical thinking such learning activities are problem-solving, experimenting and testing of speculations. This finding is not in line with that of Rassool and Rawl [16] who found that reflector learning style was the most prevalent among the nursing students.

On the same vein, the reflector learning style, emerged as the second most influential predictor variables for critical thinking is not surprising but expected. This is because its impact on critical thinking is traceable also to the fact that, the learning activities they like to involve themselves are the ones that involve self-analysis and careful deep thinking. Again reflectors are not the learners that rush over taking actions/decisions but they usually take their time to observe and contemplate over other people's actions in order to draw good conclusions. These processes entail a deeper and expanded level of their thinking leading to the acquisition of critical thinking skills. This finding did not support any earlier ones such as Nasrabadi [18] and Mahmoud [22].

In another dimension, the positive standardized regression coefficients (beta value) for pragmatist learning style in models 1 and 2 is also another indicator of its significant contributions in the prediction of critical thinking, the positive beta values imply that as the student's preferences in pragmatist learning style increase their level of critical thinking also increases indicating direct prediction on critical thinking. Reflector learning style also has a direct prediction of critical thinking as the positive beta value suggested. That is without considering the other predictors, as the preference of students in reflector learning styles increases their levels of critical thinking also increased.

Another finding from the study was that theorists and activists learning styles were excluded from the models. This indicated that both theorists and activists had insignificant contributions in the prediction of critical thinking of the undergraduates. Their insignificant contributions were proven by their beta values and their corresponding t-values which were significant at p-values greater than the cut-off point of alpha level 0.05. However, the negative beta value of theorist learning style implies that as the students' preference in it increase their level in critical thinking decrease insignificantly indicating inverse prediction. On the other hand for activists, although its contribution to the prediction of critical thinking was insignificant its little contribution was a direct one. That is as students preferences increase in activists their level of critical thinking increase insignificantly. The finding of insignificant contributions of theorist was not expected because they are the learners that are very keen in analyzing and synthesizing ideas expected to stimulate critical thinking. Again for the activists, they are learners who learn by doing and they enjoy learning activities such as brainstorming, group discussion and role-play. It was expected that these learning activities could trigger critical thinking meaningfully. However, their insignificant contributions may be that the learning activities associated with theorists and activists are not connected to reality of life so do not lead to a high level of critical thinking.

This finding is not similar to that of Ghazivakili et al. [19] who found that learning styles significantly influence the critical thinking of students. This dissimilarity between the two findings may be primarily due to the difference in the models of learning styles used. The present study used Honey and Mumford model of learning style while the previous study used Kolb's model of learning styles. Again the past research was not on the relationship between the learning styles and critical thinking while that was the focus of the present one.

5. CONCLUSION

From the findings of this study, it is concluded that learning styles are determinants of critical thinking. However, pragmatists are the most influential learning styles followed by reflectors, theorists and then activists.

6. RECOMMENDATIONS

1. Students should be nurtured and counsel to have a high preference for learning styles that can effectively trigger higher acquisition of critical thinking skill such as learning styles as reflector and pragmatists.
2. There should be an avenue to assess the undergraduates/ students' level of critical thinking. This will go a long way to determine their learning styles preference on time so as to proffer solution on how to assist those that preferred learning styles that are not directly associated with high level of critical thinking.
3. Students should be made to determine their learning styles' preferences so as to know appropriately the next line of action to be taken. That is either to encourage or discourage their learning styles preferences depending on their type.
4. Students should be exposed to learning activities that trigger a high level of critical thinking.

CONSENT

As per international standard or university standard written students consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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