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DEVELOPMENT AND STANDARDIZATION OF A SCALE FOR MEASURING REFLECTIVE THINKING OF POSTGRADUATE STUDENTS

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ABSTRACT

The study was aimed at developing and standardizing a scale for measuring reflective thinking of postgraduate students. The population of this study consists of 2300 postgraduate students. A sample of 500 postgraduate students was selected using systematic random sampling. The instrument was a four-point scale for Measuring Reflective Thinking of Postgraduate Students (MRTPS) developed by the researcher. The subscale is composed of three levels: technical reflective thinking (24 items), practical reflective thinking (19 items), and critical reflective thinking (17 items). The three (3) levels structure was confirmed using exploratory factor analysis on the construct validity of the instrument. Kaiser-Meyer-Olkin (KMO) test was 0.209, and the value of the Barlett test was found to be significant (χ^2 = 38531.008; p = .000). The results of the KMO and Barlett tests have shown that the data were suitable for factor analysis. The data collected was tested using t-test statistics at a 0.05 level of significance. The finding revealed that out of 60 items subjected to factor analysis, 52 items were considered factorial pure, and valid. It also revealed that the 52 items considered after factor analysis showed a reliability coefficient of .860 as a measure of internal consistency and the norm of males and females in the scale for measuring reflective thinking of postgraduate students did not differ significantly. Based on the findings it was recommended that this instrument for measuring the reflective thinking of postgraduate students should be adopted for use in universities for postgraduate students.

Keywords: Development, Standardization, Reflective Thinking and Postgraduate Students**.**

Introduction

Modern society is becoming more complex, information is becoming available and changing rapidly prompting users to constantly switch directions, change problem-solving strategies, think, and rethink

(Neha & Mittal, 2018). Thus, it is increasingly important to carry out reflective thinking during learning to help learners in developing strategies to apply new knowledge to complex phenomena in their day-to-day activities. According to Khalid, Ahmad, Karim, Daud, and Din (2015), the ability to reflect on one's learning and to learn from reflecting on experience is a fundamental skill for learning and improvement.

Reflective thinking is a systematic process of making informed and logical decisions on educational-related matters to assess the consequences of those decisions (Demirel, Derman & Karagedik, 2015). Neha and Mittal (2018) opined that reflective thinking is a dynamic process that evolves as you learn from your experiences and it is apply to problem solving. Reflective thinking is defined as a way of thinking that aims to determine the factors that affect the learning level and methods of the individual, positively or negatively to solve problems (Akdemir, 2018). Reflective thinking involves cognitive faculties in resolving complicated situations in learning. It is a process of reviewing experience; making judgements about it, and setting up actions or strategies for implementation. Reflective thinking involves higher-order thinking skills and therefore requires deep thinking, and the ability to rationalize every decision made (Khalid, Ahmad, Karim, Daud, & Din, 2015).

Orakci (2021) identified three levels of reflective thinking which include technical, practical, and critical reflections. Technical reflection is the basic level of reflection. It is the first level of reflection that deals with methodological fundamental issues and the development of theory to achieve certain goals. Students at the level of technical reflection are generally individuals with little experience, who choose the lessons appropriate for them and aim to achieve the learning objectives set in the lessons (Orakci, 2021). Taggart and Wilson (2005) opined that, learners reflecting at the technical level function with minimal schemata from which to draw when dealing with problems. The level of practical reflection allows efforts that can be made to achieve a particular goal. These efforts can be made based on assumptions. Individuals' learning can be facilitated by reflective thinking through applications. Reflection at the practical level can be defined as a reflection area where learners begin to benefit from their experiences in teaching skills, and try to think about the problems they encounter and find solutions (Ünver, 2010). The critical level of reflection has a broader explanation that includes levels of practical and technical reflection. Critical reflective thinking can be described as a process where an individual actively and skillfully conceptualizes, applies, analyzes, synthesizes, or evaluates information gathered from experiences, reflection, reasoning, observation, and communication. According to Bozan (2021), reflective thinking is one of the higher-order thinking skills that enables students to learn more easily and permanently. Students with high reflective thinking skills will be more

successful both in their academic and social life in a university setting and the like.

The universities were established with the intent of providing manpower essential for the emerging public service towards the economic growth of the nation (Anierobi & Unachukwu, 2020). Accordingly, one of the fundamental aims of university education in Nigeria is the creation of elites and the production of skillful human resources as an arsenal for the development of the nation's development and economic boost (Jegede, 2017). Universities all over the world are recognized as institutions established for the advancement of knowledge, scholarship and innovation (Olibie, Agu & Uzoechina, 2015). They further stated that the postgraduate education landscape simultaneously undergoes rapid and tremendous changes with emphasis on research through equipping students with the necessary skills and knowledge to foster the growth of independent, creative, and lifelong researchers. According to Anierobi and Unachukwu (2020), postgraduate students are generally looked upon as scholars. They are seen as intellectuals who are capable of running their academic programmes through individual study and active engagement in all academic activities provided by their higher institutions of learning. It was observed that postgraduate students do not have the needed competence to excel and make meaningful contributions to society. This could be a result of inadequate competency in reflective thinking skills which could enhance their academic prowess. However, it is necessary to develop a scale of reflective thinking that will enhance the realization of postgraduate students' academic attainment.

Scale development is a process of developing a reliable and valid measure of a construct to assess an attribute of interest (Tay & Jebb, 2017). They further stated that there are two distinct approaches to scale development. A deductive approach focuses on using theory and the already-formed conceptualization of construct to generate items within its domain. This approach is useful when the definition of the construct is known and substantial enough to generate an initial pool of items. By contrast, an inductive approach is useful when there is uncertainty in the definition or dimensionality of the construct. The development of scale can be likened to generalizability theory.

According to Brennan (2003), generalizability theory offers an extensive conceptual framework and a powerful set of statistical procedures for addressing numerous measurement issues. In the same vein, generalizability (G) theory is a psychometric theory based on a statistical sampling approach that partitions scores into their underlying multiple sources of variation (Li, Shavelson, Yin & Wiley, 2015). They stated that G theory addresses the fact that scores assigned to persons vary not only due to personal differences in the personality, behaviors, symptoms, abilities, or skills measured but also due to various sources of measurement error associated with "facets" of the measurement. G theory recognizes that the decision-maker might want to make two

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types of decisions based on a behavioural measurement: relative (norm-referenced) and absolute (criterion- or domain-referenced). A relative decision focuses on the rank order of persons; an absolute decision focuses on the level of performance, regardless of rank. Error variance is defined differently for each kind of decision. To reduce error variance, the number of conditions of the facets may be increased in a manner analogous to the Spearman-Brown prophecy formula in classical test theory and the standard error of the mean in sampling theory. G theory distinguishes between two reliability-like summary coefficients: a Generalizability (G) Coefficient for relative decisions and an Index of Dependability (Phi) for absolute decisions (Webb & Shavelson, 2005).

However, Orakci (2021) in his study on teachers' reflection and level of reflective thinking on the different dimensions of their teaching practice revealed that teachers reflected on teaching methods and techniques, activities and materials, student motivation, classroom atmosphere, and ensuring participation in the lesson. In the same vein, Demirel, Derman and Karagedik (2015) in their study on the relationship between reflective thinking skills toward problem-solving and attitudes toward mathematics discovered that there is no significant difference between the students' reflective thinking skills toward problem-solving and their gender, and there is a moderate significant difference between the students' reflective thinking skills towards problem-solving and their attitudes towards mathematics. Naghdipour and Emeagwali (2013) in their study on assessing the level of reflective thinking in ELT students found out that age and the level of education are two key determinants of reflective thinking behaviour. They concluded that grooming students to become reflective thinkers is key to enhancing their knowledge about useful strategies with which they can reflect on their learning and practice to face today's fundamental challenges in education. Hence this study sought to develop and standardize a scale for measuring the reflective thinking of postgraduate students.

Purpose of the Study

This study aimed to develop and standardize a scale for measuring the reflective thinking of postgraduate students. Specifically, the study aimed at:

1. developing a scale for measuring the reflective thinking of postgraduate students.
2. establishing the construct validity of the scale for measuring reflective thinking of postgraduate students.
3. estimating the reliability analysis of the instrument.
4. establishing the norms for the scale

Research Questions

The following research questions were formulated for the study.

1. How valid are the items of the scale for measuring the reflective

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thinking of postgraduate students in terms of their factor loadings?

2. What is the reliability coefficient of the scale for measuring the reflective thinking of postgraduate students?
3. What is the norm of the scale for measuring the reflective thinking of postgraduate students?

Hypotheses

The following null hypotheses were tested at a 0.05 level of significance.

Ho_1: The norm of males and females in the scale for measuring reflective thinking of postgraduate students will not differ significantly.

Ho_2: There is no significant difference between the norms of male and female students in the technical reflection of the scale for measuring the reflective thinking of postgraduate students.

Ho_3: There is no significant difference between the norms of male and female students in the practical reflection of the scale for measuring the reflective thinking of postgraduate students.

Ho_4: There is no significant difference between the norms of male and female students in critical reflection of the scale for measuring reflective thinking of postgraduate students.

Methods

The study aimed at developing and standardizing a scale for measuring the reflective thinking of postgraduate students. The population of this study consists of postgraduate students that cut across all the departments representing the postgraduate school. A sample of 500 postgraduate students was selected randomly from a population of 2300 postgraduate students in the 2022/2023 academic session using systematic random sampling. The instrument was a Scale for Measuring Reflective Thinking of Postgraduate Students **(SMRTPS)** developed by the researcher which was patterned after a four-point Likert scale (Strongly agree, agree, disagree, and strongly disagree). The subscale is composed of three levels: technical reflective thinking (24 items), practical reflective thinking (19 items), and critical reflective thinking (17 items). The three levels or factors were subjected to principal components analysis with varimax rotation. The three (3) levels structure was confirmed using exploratory factor analysis on the construct validity of the instrument. Kaiser-Meyer-Olkin (KMO) test was 0.209, and the value of the Barlett test was found to be significant ($\chi 2 = 38531.008$; $p = .000$). The results of the KMO and Barlett tests have shown that the data were suitable for factor analysis. The data collected was tested using t-test statistics at a 0.05 level of significance using the Statistical Package for Social Sciences (SPSS) version 23.

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Results

Research question one: How valid are the items of the scale for measuring the reflective thinking of postgraduate students in terms of their factor loadings?

Table 1: The items of the scale for measuring reflective thinking of postgraduate students in terms of their factor loadings.

Items	Factor Loading
26, 27, 32, 36, 38.	Loaded on factor one
17, 22, 28, 31.	Loaded on factor two
30, 42, 43, 44.	Loaded on factor three
11, 13, 18, 34, 41.	Loaded on factor four
10, 19, 45.	Loaded on factor five
20, 29, 40.	Loaded on factor six
3, 4, 5.	Loaded on factor seven
47, 55, 56, 57.	Loaded on factor eight
23, 34.	Loaded on factor nine
8, 12.	Loaded on factor ten
50, 54, 59.	Loaded on factor eleven
25, 35.	Loaded on factor twelve
46, 52, 53, 60.	Loaded on factor thirteen
16.	Loaded on factor fourteen
1.	Loaded on factor fifteen
6.	Loaded on factor sixteen
33.	Loaded on factor seven
48, 49.	Loaded on factor eighteen
51.	Loaded on factor nineteen
58.	Loaded on factor twenty
2, 7, 9, 14, 15, 21, 24, 37.	Not Loaded

Table 1 showed the items of the scale for measuring the reflective thinking of postgraduate students in terms of their factor loadings. It showed the factor loadings for all the 60 items that were subjected to factor analysis. The factors extracted were 20 and 52 items loaded up to 0.50 or the three levels or factors. The items are 1, 3, 4, 5, 6, 8, 10, 11, 12, 13, 16, 17, 18, 19, 20, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 53, 54, 55, 56, 56, 57, 58, 59, 60. Items 2, 7, 9, 14, 15, 21, 24, 37 had no factors loading on them. Hence, the items were dropped leaving behind 52 items considered factorial pure, and valid. This is shown in table 2 below.

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Table 2: Summary of Loading Items

Factor	Items	Factor Loading
1	1	.730
	3	.818
	4	.617
	5	.626
	6	.879
	8	.538
	10	.744
	11	.566
	12	.878
	13	.710
	16	.723
	17	.632
	18	.753
	19	.793
	20	.563
	22	.585
	23	.602
2	25	.573
	26	.829
	27	.535
	28	.882
	29	.700
	30	.746
	31	.734
	32	.621
	33	.746
	34	.614
	35	.789
	36	.775
	38	.743
	39	.824
	40	.731
	41	.509
	42	.738
	43	.788
3	44	.658
	45	.596
	46	.637
	47	.774
	48	.835
	49	.560
	50	.651

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51	.839
52	.857
53	.555
54	.672
55	.819
56	.664
57	.662
58	.742
59	.809
60	.521

Research question two: What is the reliability coefficient of the scale for measuring the reflective thinking of postgraduate students?

Table 3: The reliability coefficient of the scale for measuring reflective thinking of postgraduate students.

Factors	Items	Reliability Coefficients
1	1, 3, 4, 5, 6, 8, 10, 11, 12, 13, 16, 17, 18, 19, 20, 22, 23.	.785
2	25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35,36, 38, 39, 40, 41, 42, 43.	.834
3	44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60.	.734
	All 52 items after Factor Analysis	.860

Table 3 showed the reliability co-efficient of the scale for measuring reflective thinking of postgraduate students. The result revealed that the reliability of the 3-factor was estimated using Cronbach alpha methods. Factor 1 showed a reliability coefficient of .785, factor 2 showed a reliability coefficient of .834, and factor 3 showed a reliability coefficient of .734. Therefore, all 52 items after factor analysis showed a reliability coefficient of .860 as a measure of internal consistency.

Research question three: What is the norm of the scale for measuring the reflective thinking of postgraduate students?

Table 4: The norm of the scale for measuring reflective thinking of postgraduate students.

Gender	N	Mean	SD	Number of Items
Male	89	149.99	17.212	52
Female	411	149.03	19.546	52

Table 4 showed the norm of the scale for measuring reflective thinking of postgraduate students. It revealed that male students had a mean score of 149.99 with standard deviation of 17.212 while female students had a means score of 149.03 with standard deviation of 19.546 of the 52 items.

Hypothesis one: The norm of males and females in the scale for measuring reflective

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thinking of postgraduate students will not differ significantly.

Table 5: t-test of independent sample on the norm of males and females in the scale for measuring reflective thinking of postgraduate students.

	Gender	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Reflective Thinking	Male	89	149.99	17.212	.465	.643
	Female	411	149.03	19.546		

$\alpha = 0.05$

Table 5 showed a t-test of .465 and a p-value of .643. Testing at an alpha level of .05 the p value is greater than the alpha level. Hence, the null hypothesis which states that the norm of males and females in the scale for measuring reflective thinking of postgraduate students will not differ significantly is retained. The result indicated that the norm of males and females in the scale for measuring reflective thinking of postgraduate students will not differ significantly.

Hypothesis two: There is no significant difference between the norms of male and female students in the technical reflection of the scale for measuring the reflective thinking of postgraduate students.

Table 6: t-test of independent sample on the norms of male and female students in technical reflection of the scale for measuring reflective thinking of postgraduate students.

	Gender	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Technical Reflection	Male	89	58.01	8.773	1.498	.136
	Female	411	56.44	9.826		

$\alpha = 0.05$

Table 6 showed a t-test of 1.498 and a p-value of .136. Testing at an alpha level of .05 the p value is greater than the alpha level. Hence, the null hypothesis which states that there is no significant difference between the norms of male and female students in technical reflection of the scale for measuring reflective thinking of postgraduate students is retained. This implies that there is no significant difference between the norms of male and female students in the technical reflection of the scale for measuring the reflective thinking of postgraduate students.

Hypothesis three: There is no significant difference between the norms of male and female students in the practical reflection of the scale for measuring the reflective thinking of postgraduate students.

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Table 7: t-test of independent sample on the norms of male and female students in practical reflection of the scale for measuring reflective thinking of postgraduate students.

	Gender	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Practical Reflection	Male	89	51.00	8.792	.374	.709
	Female	411	50.61	9.445		

$\alpha = 0.05$

Table 7 showed a t-test of .374 and a p-value of .709. Testing at an alpha level of .05 the p value is greater than the alpha level. Hence, the null hypothesis which states that there is no significant difference between the norms of male and female students in practical reflection of the scale for measuring reflective thinking of postgraduate students is retained. This implies that there is no significant difference between the norms of male and female students in the practical reflection of the scale for measuring the reflective thinking of postgraduate students.

Hypothesis four: There is no significant difference between the norms of male and female students in critical reflection of the scale for measuring the reflective thinking of postgraduate students.

Table 8: t-test of independent sample on the norms of male and female students in critical reflection of the scale for measuring reflective thinking of postgraduate students.

	Gender	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Critical Reflection	Male	89	43.37	4.289	-1.720	.086
	Female	411	44.56	6.204		

$\alpha = 0.05$

Table 8 showed a t-test of -1.720 and a p-value of .086. Testing at an alpha level of .05 the p value is greater than the alpha level. Hence, the null hypothesis which states that there is no significant difference between the norms of male and female students in critical reflection of the scale for measuring reflective thinking of postgraduate students is retained. This implies that there is no significant difference between the norms of male and female students in critical reflection of the scale for measuring the reflective thinking of postgraduate students.

Discussion of findings

The findings on the items of the scale for measuring reflective thinking of postgraduate students in terms of their factor loadings showed the factor loadings for all the 60 items that were subjected to factor analysis. The factors extracted were 20 and 52 items loaded up to 0.50 as the benchmark for selecting an item for the three levels or factors. The items are 1, 3, 4, 5, 6, 8, 10, 11, 12, 13, 16, 17, 18, 19, 20, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39, 40,

41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 53, 54, 55, 56, 56, 57, 58, 59, 60. Items 2, 7, 9, 14, 15, 21, 24, 37 had no factors loading on them. Hence, the items were dropped leaving behind 52 items considered factorial pure, and valid. This corroborates the study of Aşkin-Can and Yildirim (2014) on the instrument for determining the levels of reflective thinking among elementary school students which found that out of 32 items, 17 items were loaded on 4 factors. In the same vein, Esomonu and Okeaba (2016) in their study on the development and standardization of inventory for measuring students' integration into university academic culture found that 27 items loaded well on three factors with minimum loading of 035.

Furthermore, the findings on the reliability coefficient of the scale for measuring reflective thinking of postgraduate students revealed that the reliability of the 3-factor was estimated using Cronbach alpha methods. Factor 1 showed a reliability coefficient of .785, factor 2 showed a reliability coefficient of .834, and factor 3 showed a reliability coefficient of .734. Therefore, all 52 items after factor analysis showed a reliability coefficient of .860 as a measure of internal consistency. This is related to a study carried out by Aşkin-Can and Yildirim (2014) who stated that when the coefficient reliability is 0.70 and above the instrument is considered reliable.

Finally, the findings on the norm of the scale for measuring reflective thinking of postgraduate students revealed that male students had a mean score of 149.99 with a standard deviation of 17.212 while female students had a means score of 149.03 with a standard deviation of 19.546 of the 52 items. Hypothesis one revealed that the norm of males and females in the scale for measuring reflective thinking of postgraduate students did not differ significantly. In the same vein hypotheses 2, 3, and 4 revealed that that there is no significant difference between the norms of male and female students in technical reflection, practical reflection, and critical reflection of the scale for measuring reflective thinking of postgraduate students. This implies that the norm of males and females in the scale for measuring reflective thinking of postgraduate students did not differ significantly. This is related to a study carried out by Demirel, Derman & Karagedik (2015) on the relationship between reflective thinking skills toward problem-solving and attitudes toward mathematics found that no significant difference exists between the students' reflective thinking skills toward problem-solving based on their gender. In the same vein, Mahasneh (2013) in his study on the relationship between reflective thinking and learning styles among a sample of Jordanian university students found that there is no significant difference in the level of habitual action, understanding, reflection, and critical reflection reflective thinking between male and female respondents.

Conclusion

The major conclusion reached from the finding revealed that out of 60 items

subjected to factor analysis, 52 items were considered factorial pure, and valid. It also revealed that the 52 items considered after factor analysis showed a reliability coefficient of .860 as a measure of internal consistency and the norm of males and females in the scale for measuring reflective thinking of postgraduate students did not differ significantly.

Recommendations

Based on the conclusion reached from the findings, the following recommendations were made.

1. This instrument for measuring the reflective thinking of postgraduate students should be adopted for use in universities for postgraduate students.
2. Future academic researchers should adopt this instrument when researching and assessing postgraduate reflective thinking skills.
3. University management should adopt this instrument as a remediation tool for diagnosing postgraduate reflective thinking skills.

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A Scale for Measuring Reflective Thinking of Postgraduate Students

Section A

Name of Institution: ……
Programme: PGDE ( ), Masters ( ), and PhD ( )
Gender: Male ( ) Female ( )
Academic Session: …….

Section B

Instructions: Several statements that people have used to describe themselves are given below. Read each statement and on a scale of one to four, tick the appropriate option that best explains your feelings. There are no right or wrong answers. Just give the answers that seem to describe your opinion in terms of the following: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD).

S/N	Items	SA	A	D	SD
	Technical Reflective Thinking				
1.	I think of my preparedness before embarking on my postgraduate studies.				
2.	I think going to class regularly would be the best for me.				
3.	I think of the best method to adopt in asking and answering questions in the classroom to avoid embarrassment.				
4.	When reading and studying, I think of how best to use my productive time.				
5.	I think of concept notes to enhance my collaboration with classmates.				
6.	I do think of my study with whole-heartedness.				
7.	I take an interest in thinking about my studies.				
8.	I think of how best to follow my course lessons rigidly from beginning to end.				
9.	I think of how best to read and focus on my studies.				
10.	I take all my courses seriously with a deep thought of success.				
11.	In terms of approach; I think of how best to meet my lecturers one-on-one.				
12.	I think of appropriate rapport when I engage my lecturers in conservations.				
13.	I give less thought to my lecturers' method of teaching.				
14.	I do not think of my lecturers' character during classes.				
15.	I like reflecting on my past performances during examinations.				

16. I do not think of reading my books until the examination timetable is out.
17. I think of how to develop my notes before the examination.

Practical Reflective Thinking

18. I have no single method of resolving problems when reflecting.
19. I provide the opportunity to think of different ways of resolving problems among my peers.
20. I give proper time to reflect on issues when responding to problems.
21. I do not reevaluate the conclusion taken during decision-making.
22. I can perform relevant tasks in different ways.
23. I like to focus my attention on authentic activities that allow for collaboration during studies.
24. I write down what I learn to enhance retention and remembrance.
25. I used what I wrote to make my note for examination purposes.
26. I give deep reflection on areas in my studies where I encounter difficulties during learning.
27. I draw lessons on areas where I pass or fail in the course of the day's classes.
28. I think deeply about what I learned.
29. I think I am responsible for my studies.
30. I do not think of what will happen when I fail the examination.
31. I do not think about the good answers to questions that are raised.
32. I think about what will make me to improve in my future studies.
33. I think of those experiences that relate to my preconceived ideas.
34. I spent time thinking about how to read and study for examinations.
35. I do not focus my thinking on things that can bring out the best in my studies.

Critical Reflective Thinking

36. I think of skills that require accurate analysis of issues in my studies.
37. I do not use abstract thinking in finding solutions to problems from multiple viewpoints.
38. I think of my efforts and experiences when finding solutions to problems.
39. I think of the use of the best communication skills in interacting with my fellow students.

40. I reflect on logic and reasoning when communicating my ideas to classmates.
41. I think of what I will say before communicating ideas to people.
42. I do not think of the use of emotional intelligence when working with my classmates.
43. I think of the use of flexibility to adjust to studying habits to fit into different tasks.
44. I do not reflect on things that help me to look beyond the obvious solution to a more complicated solution.
45. I think of my ability to clearly and effectively discuss with people.
46. I think of how to combine new evidence with my ideas to evaluate my judgement.
47. I think of the understanding I will gain from friends' views during teaching and learning.
48. Whenever I want to tackle an issue, I keep rethinking to have different solutions.
49. I think of the source of an issue before finding solutions.
50. I think of the difficulties in finding solutions to problems.
51. Sometimes, I look at the ways people ask questions and think of alternative ways of finding solutions to the questions.
52. I often evaluate my experiences to learn better.

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SMRTPS Manual

Scale for Measuring Reflective Thinking of Postgraduate Students **(**SMRTPS**)**

Author: Ajabor D.N. & Prof N.P.M Esomonu (2024)

Purpose: To develop and standardize a scale for measuring the reflective thinking of postgraduate students.

Description: 52 items scale is developed and standardized for measuring the reflective thinking of postgraduate students on:

1. Technical reflection
2. Practical reflection
3. Critical reflection

Administration:

The SMRTPS should be administered individually or in groups after establishing adequate rapport with the postgraduate students. Please encourage them to read and follow the instruction at the top of scale. You may professionally need to help the students to carry out the instruction. There is no time limit for completing the SMRTPS.

Scoring:

There is direct scoring and reverse scoring of the items.

1. Direct Scoring: for the relevant item, the responses are scored thus:
   Strongly Agree 4
   Agree 3
   Disagree 2
   Strongly disagree 1
2. Reverse Scoring: for the relevant items, the responses as scored thus:
   Strongly Agree 1
   Agree 2
   Disagree 3
   Strongly disagree 4
3. Direct Score Items: 1,2,3,4,5,6,7,8,9,10,11,12,13,15,17,18,19,20,22,23,24,25,26,27,28,29, 32,33,34,36,38,39,40,41,43,45,46,47,48,49,50,51,52.
4. Reverse Score Items: 14,16,21,30,31,35,37,42,44.
5. Add the value of the direct score and reverse score items for each of the three components of the SMRTPS.
6. Add together the scores of the three sub-scales to obtain the overall measuring score.

Psychometric Properties:

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Norms

The norms reported here are mean scores obtained from different categories of postgraduate Students.

a.	Technical reflection	Male: 58.01
		Female: 56.44
b.	Practical reflection	Male: 51.00
		Female: 50.61
c.	Critical reflection	Male: 43.37
		Female: 44.56
d.	The entire instrument	Male: 149.99
		Female: 149.03

Reliability: A measure of internal consistency was established using the Cronbach Alpha statistic. The result is thus

	Reliability Coefficient
1. Technical reflection	0.785
2. Practical reflection	0.834
3. Critical reflection	0.734
4. The entire instrument	0.860

Validity: Construct validity was established using exploratory factor analysis with varimax rotation. Only items that loaded adequately were picked.

Interpretation: The norms or mean scores are the basis for interpreting the scores of the postgraduate students. Scores greater than or equal to the norms indicate acceptance while scores lower than the norms indicate rejection. The manual above shows the administrative and scoring procedure of the scale. It also shows the psychometric properties of the scale.