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Abstract

This study assessed the research literacy levels among pre-service teachers. The study adopted a descriptive design and sampled 297 pre-service teachers from two Nigerian South-eastern federal universities. Five research questions guided the study. Data was collected using a semi-structured question guide and a self-developed Research Literacy Test (RLT). Rasch model analysis established the unidimensionality and reliability of the research literacy test (RLT). Moreover, mean scores, standard deviations, t-tests and content analysis were used to answer the study research questions. The study findings showed that pre-service teachers' research literacy level was at the information literacy level. Significant differences were not found between males and females in their research literacy components except at the information level; males were generally more research literate than females. Finally, pre-service teachers indicated that they believe their faculties hold a positive disposition towards their acquisition of research literacy.

Keywords: Content Analysis, Gender, Information Literacy, Knowledge of Research Literacy, Pre-service Teachers, Rasch Model Analysis, Research Literacy, Statistical literacy

Introduction

Over the years, the concept of the teachers as researchers has been of interest to several scholars (e.g. Etherington, 2006; Kincheloe, 2003). These interests have given rise to its numerous labels, such as action research, practitioner research, critical inquiry, self-study, and collaborative inquiry. Teachers as researchers are an essential practice within educational systems. Because today's teachers, apart from being expected to be engaged in research to provide reflective practice and educational change, are also encouraged to promote an inclusive classroom and deal with students' academic and psychological aspects in the school. Thus, the concept of teachers as researchers is an unalienable component that effectively allows pre-service and in-service teachers to professionally develop their instructional delivery practices within the classroom, school, and educational community.

Studies (BERA, 2014; Cochran-Smith & Lytle, 2009) have opined that the notion of the teachers as researchers is a 'bottom-up' approach that explores solutions to real classroom problems and encourages teachers to adopt an investigative stance towards their classroom practices (Burns, 2009). Also, it is a systematic, intentional inquiry by teachers (Lytle & Cochran-Smith, 1990) to collect data and evaluate their teaching (Robinson, 1991), to enhance student outcomes, obtain insight, cultivate reflective practice, and enact good changes in the school environment and educational methods in general (Donato, 2003). Therefore, it is an effective way to prepare teachers for multiple roles as teachers and researchers, as such is the beginning of a path to being a teacher and living the teaching/research life to enhance teaching practice, student outcomes, and educational systems, making them more just and equitable for all students (Phillips & Carr, 2010).

Several works of literature have cited many positive benefits that teacher as researcher practice holds for teachers and students (see Massey & Duffy, 2004). Nonetheless, as a 'bottom-up' approach (BERA, 2014; Cochran-Smith & Lytle, 2009), teachers engaging in teachers' research are required to identify the problem to be researched, gather and evaluate evidence from diverse sources, build an intervention strategy, implement the intervention as well as keep, revise, or adjust the intervention (Babkie & Provost, 2004). Likewise, these teachers are expected to engage in responsible and sound practices (Borko et al., 2007), as well as engage in a cycle of questioning, planning, reflecting, acting, observing, re-planning, and often questioning further (Kemmis & McTaggart, 1988) which are significant components of teacher research to be able to carefully use research to influence both their practice and others' (Department for Education [DfE], 2016). This means that teachers involved in this practice will require a proper background in research, possess skills and competencies to carry out a successful research study, and most significantly, be research literate if they are to fulfil the practice's obligations.

According to Davies (1999), being research literate implies the ability to frame questions that can be answered, look for pertinent material, read and critically assess the evidence, and apply the conclusions to one's educational requirements and settings. It also denotes that an individual can analyse, interpret, and use existing research results (Yildiz et al., 2019). Additionally, it considers a person's ability to locate, grasp, discuss, and assess various research, communicate precisely about them, and use their findings for academic and professional purposes (Beaudry & Miller, 2016). Consequently, a variety of literacies make up research literacy (Beaudry & Miller, 2016). These literacies were highlighted by Ibnatul et al. (2018), who divided them into three primary categories: information literacy, knowledge of research, and statistical literacy. Information literacy allows one to recognise, locate, search for and retrieve relevant research information,

documents, and articles (Ibnatul et al., 2018). Hence, it involves skills and competencies in understanding the need for information, identifying strategies for harnessing the information, accessing the information using various tools and methods, comparing and evaluating the information sources, and establishing connections between them and other sources (Solomon et al., 2012). In addition, it entails that one would clearly define and understand the type and degree to which information is required, identify different styles and formats of relevant information sources, and consider the costs and benefits of gaining such information (Exner, 2014). Consequently, Akpovire et al. (2019) recognised information literacy abilities as crucial tools for students to fully absorb course content and broaden their knowledge outside the classroom. Since it enables students to navigate the numerous information originating from the information society and in producing top-notch research output that will further their chances of employment after graduation (Oyedapo, 2020). This means that information literacy skills cannot be taken for granted (Maurer 2016), as students who lack them may experience delays and frustration when completing course-related work that requires research (Oakeaf & Owen, 2010), or they may not be able to succeed in their academic or career pursuits (Oyedapo, 2020).

knowledge of research is an essential research literacy component that guarantees a successful research activity initiation and completion. The knowledge of the research methodology involves one's ability to specify differences among different study designs (quantitative, qualitative, and mixed methods), sampling and data collection techniques (Ibnatul et al., 2018). It focuses on one's ability to identify and design accurate research methods and comprehend the limitations and scope of the research design (Meerah et al., 2012), by providing individuals with the platform to appropriately create a research study, choose suitable and relevant sampling techniques, and develop or adopt appropriate research instruments. In light of this, the knowledge of research is one of the essential

21st-century global competence skills that students can use to navigate the complexities of a constantly changing world (Ciraso-Cal et al., 2022), while also fostering cultural and social awareness, and respectful interactions in societies that are becoming more diverse (Camara et al., 2021). On the part of prospective teachers, knowledge of the research methodology would ensure that their research activities are carried out in a manner that guarantees its reliability, validity, and sound ethical practices. It can also facilitate their comprehension of published works, and cultivate teamwork, and thoughts about a research career (Patra & Khan, 2019). Given this, the teacher's intellectual, communicative, design, critical thinking, and creative abilities are built upon it (Begunova & Qingyu, 2021).

The concept of statistical literacy implies being able to identify the limitations of a data analysis technique and interpret appropriate conclusions from the results (Meerah et al., 2012). It involves familiarity with basic statistical concepts, terminologies, statistical tests, and interpretation of statistical analysis based on various research data outputs (Ibnatul et al., 2018). Statistical literacy is a vital component of research literacy, as it provides the required skill to carry out data collection processes involving identifying, planning, and choosing accurate data gathering tools and applying appropriate research and statistical tools to interpret and manipulate data (Meerah et al., 2012). Given this, statistics are among the most important quantitative subjects in tertiary education curricula to teach and learn (Watson, 1997), as it can help future teachers who frequently come from non-quantitative backgrounds and may have negative experiences, lack confidence, and skills needed for quantitative methods, in general, to become statistically literate (Firdaus et al., 2017; Ridgway et al., 2011; Tishkovskaya & Lancaster, 2010). Also, the development of statistical literacy among students could assist students in their reading, critical questioning, interpreting, summarising, and decision-making process about a large body of information or data that may be easily misleading (Gal, 2004;

Hafiyusholeh et al., 2017; Rumsey, 2002; English & Watson, 2015). As well as contribute effectively to debates about specific contexts in an informed way (Carmichael, 2010). Hence, they can attain self-confidence in their mathematical, numeracy, problem-solving and statistical competencies and therefore more willing and more likely to allow themselves the freedom to engage in the trial-and-error processes essential to building this type of knowledge (Organization for Economic Cooperation and Development [OECD], 2015).

Numerous papers have emphasised the value of including research in tertiary education curricula. This is because, in 21st-century learning contexts, teaching professionals must be able to critically evaluate and incorporate relevant research to guide and create effective teaching and learning approaches (Waring & Evans, 2015). Thus, the attainment of research literacy is a primary professional development concern for all cadre of teachers (Cain & Milovic, 2010; Hine, 2013; Ulla et al., 2017; Ulla, 2018). Apart from being an essential component for success in teachers' work in academia, it also enables teachers to design and conduct research using various quantitative, qualitative, and mixed methods approach (Dow & Sutton, 2014). Research literacy allows teachers to put theories into practice (Johnson, 2012; McNiff, 2010) and the skills necessary to identify school and classroom-based problems and how to address those problems systematically (Hine, 2013). Additionally, it provides teachers with knowledge on various academic topics the motivation and confidence to teach (Borg, 2014), opportunity to reflect and examine other ways of undertaking classroom instructional practices to learn from pre-existing classroom issues (Ulla et al., 2017), and strategies to improve teachers' lifelong learning and continuing professional development (Cain & Milovic, 2010; Ulla et al., 2017). On this basis, research literacy elevates the value of teachers' work and profession (Ulla, 2018) by equipping them with the professional research skills necessary for transformative and innovative

education (Hine & Lavery, 2014) and helping them deal with the insecurity and embarrassment that comes with conducting research (Naoreen & Adeeb, 2014). Consequently, prospective educators must be prepared to apply research knowledge in the classroom (Shank & Brown, 2007).

Research Literacy Among Preservice Teachers in Nigeria Tertiary Education System

Recently, education institutions and instructors have begun understanding how important it is to ensure students develop skills (Gebhardt et al., 2019) like research literacy. According to Lillejord and Børte (2016), teacher preparation programmes in learning institutions can provide the tools and foster knowledge exchange while bridging theory and practice. These programs can also support teachers' mentoring and professional development by establishing cooperative and reciprocal relationships with schools, instructors, and students (Lillejord & Børte, 2016). In Nigerian tertiary education, research literacy is relevant, especially among colleges and faculties of education. This is evident when considering the Nigerian National Policy of Education (2004) goals, which aim to contribute to national development by providing high-quality, relevant personnel training... education, research, and knowledge sharing. Besides, faculties and colleges in various tertiary institutions in Nigeria offering teacher preparation programs adopt several strategies to ensure that students within these faculties and colleges attain research literacy. Firstly, these communities align teacher preparation programmes to provide course modules majoring in research methods and statistics. To this end, the research methods and statistics course is designed to consist of course modules such as nature, classification, and information sources of educational research, basic types of educational research, research designs, instrumentation, and data processing and statistical techniques (National Open University of Nigeria [NOUN], 2012). The purpose of these learned modules is to help these students with planning, sourcing literature,

reviewing relevant research literature, formulating hypotheses, designing data collection tools, utilising the appropriate empirical analysis to find solutions to their classroom challenges, and interpreting and communicating these findings for adequate implementation for improved implementation classroom teaching and learning.

Also, these various teacher preparation programs offer teaching practice opportunities for pre-service teachers to engage in multiple classroom practices. Furthermore, in the bid to transition from theory to practice, these faculties facilitate student acquisition of research literacy by incorporating extensive teaching and learning strategies, including seminar presentations, term papers, individual and team projects, research project writing, scientific and practical conferences, and group discussions. Subsequently, these faculties also provide these students with supervisors to guide them from the beginning of the project to its end. Additionally, in solving complex classroom issues, these teachers employ systematic strategies in their classroom practices.

The primary rationale for all these is to encourage pre-service teachers' skills development in scientific method investigation, assist students in disseminating their findings through writing scientific articles (Gordillo, 2019), and develop research literacy skills to become successful teacher-researchers. Likewise, it also provides pre-service teachers with first-hand experiences to facilitate their pedagogical knowledge, research skills, professional development, and social networking and collaboration skills, which are paramount for a successful teaching and research career.

Literature Review

Some authors (Evans et al., 2017) have noted that research literacy is crucial for encouraging a practice that integrates research; however, it is still a field that needs much improvement. Some authors have reiterated the importance of the teachers as researchers and research literacy to teachers'

professional development (Cain & Milovic, 2010; Etherington, 2006; Hine, 2013; Kincheloe, 2003; Ulla et al., 2017; Ulla, 2018). Ellis and Loughland's (2016) study on the challenges of practitioner research found issues of insufficient or no research training among students. Ho et al. (2010) study revealed issues of inadequate knowledge of data-related processes and a lack of understanding of the research writing process. Al-Shudaifat's (2020) study showed that some pre-service teachers know how to design action research theoretically but lack the capacity and competencies to implement it. However, Hines et al. (2015) agreed with some other authors that educational research courses effectively improve students' use and involvement in research.

Literature reviews have asserted that certain variables such as gender and perception could significantly influence research literacy acquisition. According to scholars (see Ford et al. 2001; Samani et al. cited in Oyedapo, 2020; Weiser, 2000), gender can be a strong demographic predictor of an individual's attitude, behaviour, and perception towards research literacy and the acquisition of adequate literacy skills. Thus, gender is a construct that needs more scrutiny (Pinto et al. 2019) regarding research literacy studies, as an understanding of gender differences will aid provide better developmental strategies for pre-service teachers to acquire the needed information literacy skill and contribute to better learning and research (Macpherson, 2004). Some results suggest that males and females differ in their knowledge of concepts (Hayes, 2001); however, the degree varies considerably, as some other studies have identified significantly high gender ratios of 3:1 or higher (Miles et al., 1998). Some other studies focusing on teachers' perceptions reported that teachers held an opposing view and attitude regarding doing research (Borg, 2014; Dehghan & Sahragard, 2015), and this shaped their instructional practice, while Al-Obaydi et al. (2021) revealed that pre-service teachers had positive perceptions toward action research. Generally, studies (Risqi & Ekawati,

2020; Yolcu, 2014) have noted that issues of differences or no difference between males and females could stem from the fact that the female sex does not necessarily mean feminine or that the male sex necessarily means masculine, that there are possibilities that individuals are androgyny or indistinguishable.

Statement of the Problem

The concept of teachers as researchers has been of interest to several scholars. This is because of its attendant purposes and benefits to students, especially teachers, in their professional development. Furthermore, teachers acting on the dual role of teacher and researcher are expected to complete instructional and research-based obligations to students and the academic community. This requires teachers to have adequate background in the field of research, possess skills and competencies to carry out successful research, and most significantly, be research literates. Unfortunately, certain studies have reported that teachers face challenges ranging from a lack of cognitive abilities to undertake research, poor research knowledge, inability to understand statistical procedures, and lack of the ability and necessary skills to put theory into practice.

Furthermore, the number of studies regarding research literacy in the educational field is fewer than in health practitioners' studies. Most of these studies focused on the academic context and majored in developing research literacy course modules for graduate and undergraduate students (Ibnatul et al., 2018). These scenarios necessitate the need to undertake this study to assess pre-service teachers' (prospective teacher-researcher) research literacy level, identify whether their research literacy depends on their gender, and ascertain their beliefs about their faculty disposition towards their acquisition of research literacy.

Research Question

1. What are the pre-service teachers' mean scores on the various component levels of research literacy?
2. Is there a difference between pre-service male and female teachers based on their research literacy components, i.e., (a) information literacy level, (b) knowledge of research methodology level, and (c) statistical literacy level?
3. What is the mean score of male and female pre-service teachers' performance in the research literacy test?
4. Is there a difference between pre-service teachers' male and female overall research literacy?
5. What are the male and female pre-service teachers' perceptions of their faculty disposition towards acquiring research literacy?

Theoretical Underpinnings

Literacy conceptions have revolutionised over the past few years, resulting in research literacy being considered an evolving form of literacy (Jemsy, 2018). This suggests a shift from the predominant definition of literacy as the ability to read, read and write, speak, listen, view, think and communicate effectively for real-life applications (Cooper, 1997; Zygouris-Coe, 2001) into a socio-cultural context grounded in the work of Vygotsky (1978); that assumes new definitions, practices and specialised literacies.

According to Street's (1984) proposal, two models of literacy as a social practice exist: ideological and autonomous literacy. Street (1993) noted that the ideological model describes how literacy is grounded in its use and how it relates to power structures within society. The model stresses that a specific form or type of literacy may emerge based on two factors; the socio-cultural context and the power to do, and in this case, the capacity to do research is research literacy (Jemsy, 2018). On the other hand, the autonomous literacy model looks at literacy as a set of skills. These skills

constitute specialised literacies (Shank et al., 2014), including information/technological, visual, numeracy, and verbal literacy (Beaudry & Miller, 2016).

The perspective of research literacy as a socio-cultural context has given rise to individuals' application of its theory into practice; thus, it can be practised within several contexts (research, health, etc.) and other settings (academia, industry, etc.). However, pre-service teachers need to learn and possess specific skills central to the concept to apply theoretical perspectives of research literacy into practice. These particular skills central to the idea involve the ability to identify and use information sources, design accurate research methods, and apply appropriate data analysis procedures to arrive at conclusions that are not misleading. Hence, research literacy implies the pre-service teachers' capacity to develop a realistic picture of how research functions, as well as the ability to purposefully access, comprehend (see Shank et al., 2014), reflect and communicate scientific information accurately and use or apply findings for academic and professional purposes (Groß-Ophoff et al. 2014; McMillan & Schumacher, 2010).

The socio-cultural perspective of research literacy also underlines the need for specialised literacies. These literacies, which are diverse and constitute different literacies, include information/technological, visual, numeracy, and verbal literacy (Beaudry & Miller, 2016). Therefore, a pre-service teacher's ability to acquire the necessary skills and these competencies will result in them being research literate. Bearing this in mind, pre-service teachers must attain research literacy because educators within the 21st century must be equipped with very high research competence to conduct research studies for global competence that can promote cultural, and social awareness, and respectful interactions in increasingly diverse societies (Camara et al., 2021).

Methods

Design

For this study, a descriptive design was used. This design is appropriate for this study as it does not allow for manipulating the study population but rather aims at obtaining information on the characteristics, facts, or features already pre-existing in a given population. In line with this, this study sought to obtain information regarding pre-service teachers' research literacy levels and their perceptions of their faculty disposition towards acquiring research literacy. A convenience sampling technique was used to select the study sample. A convenient sampling technique which is a non-probability sampling technique, was suitable for this study since it allowed for the random and convenient selection of study respondents (data sources for the researcher). The study sample included 297 pre-service teachers from two Nigerian South-eastern federal universities. These pre-service teachers have taken education research methods and statistics courses and are also expected to undertake research activities.

Instrument

Literature has shown that overall, research literacy can be evaluated using self-report tools (Adedokun et al., 2013; Borg & Alshumaimeri, 2012; Ntuli & Kyei-Blankson, 2016) and test instruments; yet, within the education sector, these studies are scarce (Gotch & French, 2014; Reeves & Honig, 2015), but highly enormous within the field of evidence-based medicine (Groß-Ophoff et al. 2017). Because of this, an instrument titled Question Guide and Research Literacy Test (QGRLT) was developed for data collection. The QGRLT was designed to constitute three sections. Section A elicited respondents' demographic information and gender. Section B comprised a semi-structured question guide to which students were expected to respond. Contrarily, section C consisted of the research literacy test (RLT).

The Semi-Structured Question Guide

This semi-structured question guide consisted of questions regarding pre-service teachers' perception of their faculty's disposition towards their acquisition of research literacy. Some of the questions in the guide included: *Have you undertaken course modules in research methods and statistics? Are you familiar with the procedures to undertake research activities in your faculty? Are topic approvals given before any research activities can be carried out within your faculty? How can these approvals be obtained for any research activities within your faculty?*

Trustworthiness

For the trustworthiness of questions generated in the question guide (section B), these questions were designed in line with the study aims and research questions. This was to ensure the appropriateness of gathered data that will facilitate data analysis. These questions on the question guide were open-ended, and students were expected to respond to them in writing. These questions in the question guide (section B) allowed for the critical enquiry on pre-service teachers' perception of their faculty disposition towards their acquisition of research literacy to provide in-depth information on that construct. This approach was deemed fit as it allowed these students to offer extensive views on the subject in writing.

The Research Literacy Test (RLT)

The RLT (section C) was a 20-item test designed to adopt a multiple-choice test item format (four options, of which one is the plausible answer). Items on the RLT were generated using a test blueprint. This test blueprint considered the content validity of the test in line with the research methods and statistics course modules already undertaken by the pre-service teachers and the various domains of research literacy highlighted in the literature.

Validity and Reliability

Generally, measurement experts examined the semi-structured question guide and items generated within the different cognitive domains of the RLT blueprint. These experts were requested to explore the draft semi-structured question guide, and the designed RLT for several issues, including ambiguity, clarity, readability, appropriateness of items to study content, the study aims, research questions, and how it constitutes items on already learned research methods and statistics course modules. Recommendations from these experts, such as revising and rewording, reorganising items, and removing defective items, were implemented. Afterwards, the instrument (Question Guide and Research Literacy Test [QGRLT]) was trial-tested, after which item analysis for the RLT was conducted.

Table 1

Test blueprint for the research literacy test construction

Cognitive Domains	Research Literacy Domains			Total
	Information Literacy	Knowledge of Research Methodology	Statistical Literacy	
Remember	5	4	3	12
Understand	2	3	-	5
Apply	-	1	1	2
Analyze	-	1	-	1
Evaluate	-	-	-	-
Create	-	-	-	-
Total	7	9	4	20

Furthermore, Rasch model analysis, which allows all test items in a test instrument to measure a single construct simultaneously, explored the RLT items' unidimensionality. According to Linacre (2006), assessing a test instrument's unidimensionality following the principal component analysis (PCA) approach requires utilising acceptable criteria. Hence, Reckase (as cited in Alavi & Bordbar, 2017), outlining these criteria, noted that the amount of variance explained by measures must be > 20%. The unexplained variance of the Eigenvalue for the first contrast must be < 3.0 and between

1.4 to 2.0 (Linacre, 2008), as an estimate that exceeds 3.0 indicates the presence of sources of secondary effect in the data (Linacre, 2015; Tanaka, 2016). Also, the observed variance value should be closer to the expected variance value explained (Linacre, 2015). Besides, Ibnatul et al. (2018) hinted that for fit statistics, outlier sensitive analysis (outfit) should be examined based on its MNSQ value (mean square) together with its ZSTD value (standardised fit statistic). On this basis, Linacre (2002) noted that acceptable MNSQ values should range from 0.5 to 1.5, whereas the acceptable ZSTD score should range from -2.0 to +2.0 to guarantee reasonable predictability.

Table 2

Showing Standardised Residual Variance in Eigenvalue Units = Item Information Units

	Eigenvalue	Observed	Expected
Total raw variance in observations	27.1633	100.0%	100.0%
Raw variance explained by measures	7.1633	26.4%	25.9%
Raw variance explained by persons	2.9911	11.0%	10.8%
Raw variance explained by items	4.1722	15.4%	15.1%
Raw unexplained variance (total)	20.0000	73.6%	100% 74.1%
Unexplained variance in 1st contrast	2.2580	8.3%	11.3%
Unexplained variance in 2nd contrast	1.8604	6.8%	9.3%
Unexplained variance in 3rd contrast	1.7605	6.5%	8.8%
Unexplained variance in 4th contrast	1.6193	6.0%	8.1%
Unexplained variance in 5th contrast	1.5230	5.6%	7.6%

Table 2 reveals that the amount of variance explained by measures is 26.4%, which is > 20%. Also, the raw variance explained by persons was 11.0%, and the raw variance explained by items was 15.4%. This shows that the measurement dimension is greater than the requirement of 20%, meaning that the test items hold a unidimensional trait. Also, the first, second, third, fourth, and fifth unexplained variance accounted for Eigenvalues of 2.25, 1.86, 1.76, 1.61, and 1.52, respectively, which are good, as all were < 3.0, between 1.4 to 2.0, and did not exceed 3.0. The observed value of variance (26.4%) was closer to the expected value of variance

explained (25.9%). For the MNSQ and ZSTD range of values (see table 3), MNSQ values were between 0.69 to 1.43, whereas the ZSTD range of values was from -0.40 to 2.16.

Table 3
Showing Fit Statistics Table

Entry Number	Total Score	Measure	Model SE	INFIT		OUTFIT		PTMEASURAL		EXACT MATCH		ITEM
				MNSQ	ZSTD	MNSQ	ZSTD	COR	EXP.	OBS%	EXP%	
15	32	-.06	.32	1.21	1.51	1.43	2.16	A .18	.41	66.7	70.6	15
13	12	1.92	.35	1.19	1.09	1.17	.59	B .12	.30	74.5	76.7	13
7	37	-.61	.35	.97	-.13	1.15	.65	C .41	.41	78.4	77.0	7
2	34	-.27	.33	1.11	.78	1.13	.69	D .31	.41	66.7	72.5	2
6	20	1.08	.31	1.00	.02	1.13	.70	E .34	.36	66.7	67.4	6
14	24	.70	.30	1.05	.47	1.12	.73	F .33	.38	64.7	65.8	14
19	14	1.68	.33	1.05	.36	1.12	.48	G .25	.32	74.5	73.47	19
20	40	-.99	.37	1.12	.61	1.05	.27	H .33	.41	74.5	81.7	20
12	40	-.99	.37	1.02	.15	1.09	.40	I .38	.41	82.4	81.7	12
18	34	-.27	.33	1.05	.40	1.07	.42	J .36	.41	70.6	72.5	18
4	34	-.27	.33	1.06	.44	1.00	.06	j .37	.41	70.6	72.5	4
5	26	.51	.31	1.00	.04	.92	-.46	i .41	.39	56.9	66.4	5
10	39	-.86	.36	.88	-.57	.98	.02	h .49	.41	84.3	80.1	10
16	34	-.27	.33	.96	-.23	.90	-.44	g .46	.41	74.5	72.5	16
1	22	.89	.31	.94	-.55	.88	-.60	f .44	.37	72.5	66.4	1
11	43	-1.46	.42	.93	-.18	.81	-.36	e .46	.39	88.2	85.9	11
3	33	-.16	.32	.92	-.57	.91	-.40	d .49	.41	72.5	71.5	3
9	27	.42	.31	.83	-1.65	.90	-.56	c .54	.40	80.4	66.8	9
8	34	-.27	.33	.81	-1.35	.74	-1.36	b .60	.41	78.4	72.5	8
17	38	-.73	.35	.78	-1.21	.69	-1.21	a .62	.41	84.3	78.5	17
Mean	30.8	.00	.34	.99	.0	1.01	1			74.1	73.6	
P. SD	8.5	.88	.03	.12	.8	.17	.8			7.5	5.6	

Table 4
Fit Statistics Summary Table

Item Fit Statistics	Range of Values
Outfit MNSQ	0.69 to 1.43
Outfit ZSTD	-0.40 to 2.16.

Rasch model analysis also established the reliability of the RLT. The Rasch model analysis assesses latent traits in individuals and shows two reliabilities; person reliability and test item reliability. According to Linacre (2011), acceptable estimates for Rasch model reliability should be between 0.6 and 0.8. The person reliability and test item reliability of the RLT were 0.67 and 0.85, respectively. According to Linacre, these are acceptable estimates.

Table 5*Showing the Reliability of the Developed Research Literacy Test (RLT)*

Reliability Estimates	
Person Reliability	0.67
Item Reliability	0.85

Research Literacy Test Administration, Scoring, and Analysis

After adequate permission had been obtained, the researcher administered the QGRLT with the help of research assistants. The QGRLT administration was conducted during the morning hours same time the pre-service teacher's research method and statistics were to be held. The returned QGRLT was gathered after the administration period. The question guide part (section B), which elicited qualitative data for research question five, was analysed using content analysis. Content analysis is a data analysis technique relevant to technical communications and text analysis (Boettger & Palmer, 2010; Powers & Knapp, 2006) and can be used to interpret qualitative data collected on the interview protocol or test questions (Boakye, 2016). It is concerned with exploring large amounts of words, phrases, signs, and sentences to determine trends and patterns of words used, their frequency, and their relationships, to provide an in-depth understanding of the structures and discourses of communication (Boettger & Palmer 2010; Gbrich, 2007; Mayring, 2000; Pope et al., 2006). Content analysis in this study was applied inductively since the theme of interest perceptions was loosely defined to include views, opinions, and beliefs following an open data collection technique (Kyngäs, 2020). Thus, evidence regarding pre-service teachers' perception of their faculty disposition towards their acquisition of research literacy was shown using coding categories and descriptive evidence. Moreover, qualitative content analysis steps (see Elo & Kyngäs, 2008) such as preparation which involves familiarisation and identification of collected data, as well as selecting the unit of analysis, the organisation, which entails respondents coding, categorisation of theme, and reporting which deals with the reasonable

report of study results through models or a storyline were all implemented in the study.

Subsequently, the RLT part (section C), which elicited quantitative data, was scored using the conventional scoring method, where correct answers were scored with a positive value, and incorrect answers were scored with a zero value (Lesage et al., 2013). Moreover, mean scores, standard deviations, t-tests, and content analysis were adapted to answer the study research questions.

Results

Table 6:
Descriptive table for respondents' variable

Schools	Gender	Frequency
University 1	Females	117
	Males	36
University 2	Females	117
	Males	27

Question 1. What are the pre-service teachers' mean scores on the various component levels of research literacy?

Table 7
Mean score component levels of pre-service teachers' research literacy (N=297)

Component Levels of Research Literacy	\bar{x}	SD
Information Research Literacy Level	6.70	3.05
Knowledge of Research Method Level	1.46	1.02
Statistical Literacy Level	2.46	.95

Table 7 describes the component levels of pre-service teachers' research literacy. The table indicated the pre-service teachers' information literacy ($\bar{x} = 6.70$, $SD = 3.05$), knowledge of research methodology ($\bar{x} = 1.46$, $SD = 1.02$), and statistical literacy ($\bar{x} = 2.46$, $SD = .95$). This indicates that the

research literacy of pre-service teachers within the education faculties was at the information literacy level.

Question 2. Is there a difference between pre-service male and female teachers based on their research literacy components, i.e., (a) information literacy level, (b) knowledge of research methodology level, and (c) statistical literacy level?

Table 8a

Descriptive statistics between male and female pre-service teachers based on their information literacy level (N=297)

Information literacy level	Gender	\bar{x}	SD	T	Df	Sig	Remark
	Male	6.47	2.93	-2.556	295	.011	Significant
	Female	7.57	3.34				

Significant differences exist between male and female pre-service teachers based on their information literacy levels.

Table 8b

Descriptive statistics between male and female pre-service teachers based on their knowledge of research methodology level (N=297)

Knowledge of Research Methodology	Gender	\bar{x}	SD	T	Df	Sig	Remark
	Male	1.41	1.03	-1.727	295	.993	Not Significant
	Female	1.66	1.07				

Differences do not exist between male and female pre-service teachers based on their knowledge of research methodology level and statistical literacy levels.

Table 8c

Descriptive statistics between male and female pre-service teachers based on their statistical literacy level (N=297)

Statistical literacy level	Gender	\bar{x}	SD	t	Df	Sig	Remark
	Male	2.46	.96	.009	295	.085	Not Significant
	Female	2.46	.96				

Differences do not exist between male and female pre-service teachers based on their statistical literacy level.

Question 3. What is the mean score of male and female pre-service teachers' performance in the research literacy test?

Table 9

Showing the Performance Mean Score of Male and Female Pre-service Teachers in the Research Literacy Test (RLT) (N=297)

	Gender	\bar{x}	SD
Research literacy Test	Males	11.69	4.39
	Females	10.34	3.90

Table 9 showed that male pre-service teachers' mean score performance in the RLT was ($\bar{x} = 11.69$, $SD = 4.39$), while the mean score performance of female pre-service teachers in the RLT test was ($\bar{x} = 10.34$, $SD = 3.90$). This suggests that male pre-service teachers performed better in the research literacy test than female pre-service teachers.

Question 4. Is there a difference between pre-service teachers' male and female overall research literacy?

Table 10:

Descriptive statistics between male and female pre-service teachers' overall research literacy (N=297)

	Gender	\bar{x}	SD	t	df	Sig	Remark
Overall Research Literacy	Males	11.69	3.90	-2.376	295	.018	Significant
	Females	10.34	4.39				

Significant differences exist between male and female pre-service teachers' overall research literacy.

Question 5. What are the male and female pre-service teachers' perceptions of their faculty disposition towards acquiring research literacy?

Qualitative content analysis of the responses to the questions that sought to elicit pre-service teachers' perceptions of their faculty disposition towards acquiring research literacy indicated that male and female pre-

service teachers believed their faculty recognised the need to acquire research literacy. In enquiring whether they (pre-service teachers) have undertaken course modules in research methods and statistics, almost all the participants affirmed that they had undertaken some course modules in research methods and statistics. The responses include:

Yes, we have taken some course modules in research methods and statistics, including topics like research design, literature review, and data collection. For now, our lecturers have taught us some statistical calculations on frequencies, percentages, mean, t-test, and correlation (pre-service teacher 10 script)

When asked whether they are familiar with procedures to undertake research activities in their faculty, many respondents opined:

We have been taught that for someone like us (undergraduates), for example, to do research; we have to write at least and submit a proposal that must include background, a literature review, and the method we want to use for the research (pre-service teacher 17 script).

Subsequently, on whether topic approvals are given and how they can be obtained for any research activities within their faculty, all participants agreed that:

In the faculty, research topic approvals are obtained from assigned supervisors by their students engaging in research activity; they (assigned supervisors) determine what to integrate and what not to integrate into the project. Also, approvals for student projects (research) can be obtained by submitting the proposed topics to the supervisor, who will check and then approve the topic if relevant, but when not relevant, the student may be asked to review the presented topics or to discard it for a new one (pre-service teacher 25 script).

Discussion

Research question one assessed pre-service teachers' mean scores based on the various component levels of research literacy. The comparison of mean scores of the three research literacy components revealed information literacy (\bar{x} = 6.70, SD = 3.05), knowledge of research methodology (\bar{x} = 1.46, SD = 1.02), and statistical literacy (\bar{x} = 2.46, SD = .95). This suggests that the pre-service teachers within the faculties of education research literacy level were at the information literacy level. This also indicates that these pre-service teachers within the education faculties could recognise, locate, search for and retrieve relevant research information, documents, and articles pertinent to their study. It also means that they could read, understand, write research articles, access and harness the information using diverse methods, compare them, and establish connections between various information sources. The results support Akpovire et al., (2019) assertion that information literacy skills are an essential tool for students to have a complete understanding of course content and expand their knowledge beyond the classroom, as well as be able to navigate the numerous information coming from the information society, produce high-calibre research projects, and create opportunities for themselves after completing their academic studies (Oyedapo, 2020). Consequently, Oyedapo (2020) opined that reasons for the prevalence of information literacy skills among students could be attributed to the proliferation of information and communication technology (ICT) facilities on campus which are heavily patronised by students, coupled with the affordability of mobile smartphones that are internet enabled. Considering this, information literacy skills should not be taken for granted (Maurer, 2016), as students who lack them may struggle in their academic or career pursuits (Oyedapo, 2020), endure delays and frustration while attempting to complete course-related work that requires research (Oakeaf & Owen,

2010), and may not be able to adapt to and utilize innovative technological measures in that can support their learning (Okoli & Ifejika, 2022).

On the other hand, research question two revealed statistically significant differences between male and female pre-service teachers based on their information literacy level (Table 8a), as well as no statistically significant differences between male and female pre-service teachers based on their knowledge of research methodology level (Table 8b), and statistical literacy level (Table 8c). While this further solidifies the research question one claims that pre-service male teachers synthesise information more than their female counterparts; it also shows that males and females do not differ in their research and statistical literacy knowledge. This reflects that both male and female pre-service teachers have similar competencies in designing their research study, choosing suitable sampling techniques, developing or adopting appropriate research instruments, and implementing data collection and statistical procedures. This finding means that when these pre-service teachers undertake teacher research to improve their classroom or instructional, male pre-service teachers are likely to discern and harness more appropriate information sources than their female counterparts. Still, both genders may utilise similar approaches when designing or adopting research instruments and collecting or analysing data.

These findings further suggest that colleges and faculties of education should develop practices that will make it easier for all students to access information within and outside the academic environment, such that as a result of consistent opportunities to access and use information, student-teachers, especially female students, will acquit themselves with these information sources and invariably develop information literacy. Also, this finding indicates that more research training opportunities should be provided for teacher educators. This is because the reported difference in literacy skills between male and female pre-service teachers could result from their instructors' lack of expertise or poor supervision or instructional

delivery strategies, preventing them from communicating these concepts to students. Numerous literature has stated that instructors struggle to get ideas across to students when they lack knowledge about the concept. This can influence how they teach and, invariably, student learning. Also, when teachers use appropriate instructional delivery practices, students tend to be more engaged and committed to the teaching and learning process. As such, they can learn effectively. Given this, it is pertinent that instructors who teach these courses are trained to undertake these technical research areas for students to grasp the concepts and develop literacy skills. Other scholars corroborating these findings (see Ford et al., 2001; Soetan & Ominuta, 2018) stated that substantial variations in information literacy skills between male and female students favouring males. They further opined those female students experienced more difficulty finding information on the internet and felt less competent and comfortable using it. Studies (Samani et al., 2019; Weiser, 2000) further acknowledged this finding by noting that gender is a crucial demographic indicator that could influence an individual's behaviour and perception of information seeking or the acquisition of information literacy skills. As adequate information literacy skills could help students improve significantly their academic performance (Banik & Kumar cited in Oyedapo 2020) as well as empower and enhance their abilities to determine information needs, access, evaluate, use the information and understand the legal, ethical, and economic issue of information use (Oyedapo, 2020).

Similarly, findings from Pallamparthy and Basavareddy (2019), who reported most study participants to have research knowledge, support this study (Table 8b) while disagreeing with Moges et al. (2017), who revealed that female respondents appear to have better research knowledge than males. The fact that this finding agrees with several authors, including Pallamparthy and Basavareddy (2019), shows how, despite not previously being a focus, research has become more prevalent in undergraduate

degree programs (Etzkowitz, 2003). As such, it has become a means for pre-service teachers learning that could contribute to their understanding of issues, decision-making (Brew, 2012), critical thinking, and problem-solving (Missingham et al., 2016; Wass et al., 2011). Subsequently, other studies (Arora & Pawlowksi, 2017; Carmichael, 2013; Yolcu, 2014) that found no difference between males and females in mathematical and statistical literacy also identify with this study. This finding might be the result of the fact that over the years, the perceived statistical and numeracy skill gap between males and females are gradually closing up; thus, females are becoming self-confident, less anxious, and have a positive feeling about their numeracy abilities, hence, are now likely to undertake trial-and-error processes which are relevant to achieving statistical literacy. Furthermore, it could also be due to some author's (see Risqi & Ekawati, 2020; Yolcu, 2014) position that the female sex does not necessarily mean feminine, as well as the male sex does not necessarily mean masculine, that there are possibilities individuals are androgyny or indistinguishable when it comes to the issue of gender.

Research question three found that male pre-service teachers (\bar{x} =11.69, SD = 4.39) performed better than female pre-service teachers (\bar{x} = 10.34, SD = 3.90) in the research literacy test. In contrast, research question four indicated a significant difference between male and female pre-service teachers on their research literacy levels favouring males over females. This finding shows that male pre-service teachers were more skilled in undertaking research activities than their female counterparts. It also suggests that since male pre-service teachers have better research competencies, they would be much more comfortable undertaking research activities to solve their classroom problems. Likewise, this indicates that male pre-service teachers are likely to welcome research activities and are more prone to positive attitudes and behaviours towards research activities. Subsequently, these findings highlight that male teachers perceive research

activities more positively than female teachers and are more prone to practising it in the classroom than female pre-service teachers. These findings also depict pre-service teachers' positive views and perceptions of research. These pre-service teachers will also be open to research activities as they will possess specific competencies that will aid their research self-efficacy as teacher researchers. Therefore, they will have confidence in their ability to undertake research activities. This result disagrees with some authors (e.g., Imran et al., 2019), who reported no differences between male and female students in research. Additionally, other scholars (see Barron et al., 2006; Camara et al., 2021; Disenhaus, 2015; Reilly et al., 2019) found differences between males and females to favour females and also noted that females consistently outperform male students in literacy assessment such as in-text quality, language proficiency, reading, and writing proficiency (see Al-Saadi 2020; Barron et al., 2006; Disenhaus, 2015; van der Sliket al., 2015). These results are essential since research is a reading and writing-intensive intellectual activity, and students' attainment of research literacy may be influenced by their reading and writing skills (Camara et al., 2021). However, being able to conduct research is a global competence that can promote cultural and social awareness and respectful interactions among individuals and societies; thus, recognising the gender issue is crucial to ensuring that men and women can reach their full potential and are also equipped with very high research competence. (Camara et al., 2021)

Qualitative content analysis used in answering research question five showed that most pre-service teachers (both males and females) held positive perceptions of their faculty disposition towards acquiring research literacy. This finding agrees with the results of Gitlin et al. (1999), whose study tried to examine pre-service teachers' thinking of research, and Shah et al. (2020), whose study highlighted the views of prospective teachers about their institutions, noted that within these institutions, teachers did not only utilise research-based knowledge while delivering the knowledge

but also provided students with sufficient research-based academic support. This study, while being consistent with the report of Gitlin et al. (1999) and Shah et al. (2020), disagrees with the assertions of Aghauche et al. (2019) that there has been institutional negligence of literacy instruction programmes of Nigerian undergraduates as well as the deductions of Oyedapo (2020) that little or nothing has not been done by faculty and university administrators to support and sustain literacy skills of undergraduates.

Conclusion, Recommendation, Limitations, and Suggestions

Generally, findings in this study present the view that the critical components of research literacy (information literacy, knowledge of research literacy, and statistical literacy) are all essential not just for the current development of teachers but also for their lifelong learning and career practice. Furthermore, it highlights the need among teachers to possess high skill levels in each of the research literacy domains as a means to promote research competency and interconnection in a rapidly changing world in which research is an indication that the kind of education we have all over the world has been levelling up (Camara et al., 2021). Furthermore, the study reflected on gender differences which seem to be a crucial variable in all forms of literacy studies and which, over time, might have been overlooked because it is less frequently measured in educational assessments (Reynolds et al. 2015). From this, the following conclusions are drawn as a result:

1. Pre-service teachers within the various universities need to improve their skill level in the various domains of research literacy, especially in the knowledge of research literacy and statistical literacy, since they already show higher competency in the information literacy domain.

2. Significant differences were not found between males and females in their research literacy components except at the information level; males were generally more research literate than females. Thus, gender is a significant factor in all forms of literacy study and should not be overlooked, as it could hold fundamental importance in providing insights and understanding of the perceived gender gap among individuals.
3. Higher education institutions should encourage practices that foster research literacy skills among pre-service teachers. As these practices will help provide teachers with professional development and open support, partnerships, and collaboration networks for these teachers in a world where high competence in research implies competitiveness and comparability in terms of emerging demands for 21st-century global learners (Camara, 2021).

These findings imply that even though the benefit of research literacy to the pre-service teachers has been emphasised in this study, pre-service teachers within those various universities may face difficulties in undertaking the practices owing to the low skills level in the knowledge of research and statistical literacies. Hence, they may not be motivated to undertake the practice and acquire research competence. Also, the highlighted significant contribution of gender to pre-service teachers' research competence cannot be overemphasised. Thus, these universities should take adequate care in introducing practices and policies to help bridge these gaps. Subsequently, the perceived positive view that pre-service teachers have about their faculty disposition towards their acquisition of research literacy is good and should be further reinforced through more appealing practices. However, as described earlier, their observed deficiency in the knowledge of research and statistical literacy domains could pose a severe challenge to their actual involvement in the practice.

Given this, this study recommends that further efforts be made to improve pre-service teachers' research literacy, especially in its three major domains (information, knowledge of research, and statistical literacy). This is crucial because educators in the 21st century must be equipped with very high research competence to conduct research studies for global competence that can promote cultural, and social awareness, and respectful interactions in increasingly diverse societies (Camara et al., 2021). To achieve this, institutions must seek strategies, practices and policies that further facilitate information, research knowledge, and statistical literacies. One such avenue to further promote students' acquisition of information literacy could be through the provision of ICT tools and internet resources for male and female pre-service teachers, as well as granting gender-equal access and support to use these facilities. This will open up more opportunities for all to access information on the global level. Also, these institutions could seek collaborations and membership with legitimate publications, journal houses, and electronic databases (Yebowaah & Owusu-Ansah, 2020). This can assist these institutions in expanding their access to critical information required for academic research for all categories of students (Yebowaah & Owusu-Ansah, 2020).

For student acquisition of research knowledge, higher institutions should seek to redesign their curriculum and teaching methods to incorporate extensive teaching of theoretical and practical research basics. Other strategic methods of instruction these institutions should incorporate include the inclusion of problem-based curricula, scientific and practical conferences, seminars, discussion platforms, journal clubs, writing course papers, compulsory research projects, poster presentations, and group work. This can help students overcome their embarrassment and insecurity regarding research work (Naoreen & Adeb, 2014), promote active collaboration between supervisors and pre-service teachers and assist pre-service teachers in acquiring research knowledge (Billot & Codling, 2013)

and social networking skills (Thomas et al., 2011). Additionally, these institutions should provide supervisors with training opportunities to consolidate their ability to supervise students in their research work (Gorgon et al., 2013). This training in the form of workshops and seminars should focus on diverse supervision practices and mentoring styles (Niemczyk, 2018), which will be relevant to the supervisor during supervising students.

Subsequently, since teachers often come from non-quantitative backgrounds and may have negative experiences as well as lack confidence and critical skills needed for quantitative methods in general (Firdaus et al., 2017; Ridgway et al., 2011; Tishkovskaya & Lancaster, 2010), faculties and colleges of education should further seek opportunities to promote student attainment of statistical literacy. This is because it is a crucial skill that students need for reading and critical questioning, interpreting, summarising, and in their decision-making process about a large body of information or data that may be easily misleading (Gal, 2004; Hafiyusholeh et al., 2017; Rumsey, 2002; English & Watson, 2015), as well as to contribute to debates about the specific context in an informed way (Carmichael, 2010). The development of statistical literacy among all students could be encouraged by helping them attain self-confidence in their mathematical, numeracy, problem-solving, and statistical competencies. This is true because individuals with more self-confidence are more likely to allow themselves the freedom to engage in the trial-and-error processes essential to building this type of knowledge (Organization for Economic Cooperation and Development [OECD], 2015). Also, students familiar with mathematical problem solving tend to have no difficulty understanding the text and context (Prabawanto, 2019). Given this, various approaches such as curriculum and instruction delivery re-engineering should be adopted within these institutions and faculties. The current statistical curriculum within these faculties needs to be redesigned to create strong synergies between content, pedagogy and technology (Garfield & Ahlgren, 1988; Garfield, 1995;

Moore, 1997), which will result in changes to the content of statistics courses, especially introductory level courses; improvements to the instructional techniques used in statistical courses; reforms in terms of pedagogical changes; and integration of technology (Moore, 1997; Garfield, 1995; Mills, 2002). Additionally, conventional approaches to teaching statistics need to be reconsidered to adopt a problem-solving approach (Firdaus, 2017; Marriott et al., 2009), which will enable students to practice their statistics literacy through practical work and exercises (Yotongyos et al., 2015), allowing them to receive training that is both current and pertinent to society's needs (Tishkovskaya & Lancaster, 2010).

In sum, higher institutions, especially faculties and colleges of education, should further design training, seminar, and workshops programmes that will facilitate all students' information searching and identification skill, research writing, proposal, and research grant writing, and basic statistical analysis skills as this will go a long way in boosting pre-service research competence as well as prepare them for the professional service upon graduation.

This study had several limitations. Firstly, the study considered only pre-service teachers, excluding other cadres of teachers. Thus, findings in this study cannot be generalised to include other cadres of teachers. Subsequently, the RLT used in this study comprises only multiple-choice test items and excluded other forms of test items. Since multiple-choice tests have a greater propensity for test-takers cheating and blind guessing (Fehintola & Akingbade, 2019), it could be possible that what most students achieved in the test was a function of guessing and not what they had achieved. Given this, future studies could focus on assessing other cadres of teachers (in-service or assistant teachers) research literacy and whether other teacher variables depend on their research literacy. Also, other studies could adopt more test items in their research and not just multiple-choice test items.

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