Level of knowledge of Science Instructors in Conducting Scientific Research and its Implications to Teaching

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Abstract- Scientific reflective thinking is what characterizes reflective teachers. Teachers who apply scientific principles in teaching are a product of scientific research. Thus, the knowledge of the instructors in scientific research has great implications for teaching. This study aims to assess the level of knowledge of the Science Instructors in conducting scientific research and determine its implications for their teaching methodology used. The respondents of the study will be the instructors of all science courses on the CEU Manila campus. The researchers will utilize an online survey questionnaire using scales to assess the instructor's level of knowledge in conducting scientific research in terms of information-seeking skills and research methodology. It will also identify the instructor's teaching and assessment methods. Further, it will determine the implications of instructors' knowledge in conducting scientific research and the teaching and assessment methods used. Descriptive statistics that include frequency and percentage, mean and standard deviations will be used. Science Instructors have satisfactory knowledge of information-seeking skills and the highest knowledge is the basic searching, gathering, and storage of information or data in disk or email. However, critiquing and validation of information gathered is the lowest rated. Instructors mostly used basic teaching methods such as lectures and classroom discussions. However, the instructors as utilized collaborative classwork which is considered a constructivist approach to teaching. Instructors need to attend continuous training in the conduct of the research process so they will have increased knowledge and information on other strategies for the teaching and assessment process. This study is limited only to the participants the study and does not generalize the conclusions to all science teachers.

Index Terms- Scientific research, Science Instructors, Teaching methodology, assessment methodology

I. INTRODUCTION

Science teachers are being prevented from being active and effective consumers of educational science due to a lack of orientation and training on how to understand the scientific process and how this process results in cumulative growth that leads to validated educational practice [1]. Educational practice is informed by formal scientific research through the use of research-based knowledge.

Instructors started their formal scientific research in their university profession preparation courses. As they become professional teachers continue their exposure to formal scientific research by subscribing to and reading professional journals and conducting scientific research. And this is becoming a requirement for them as part of their acquisition for graduate studies and becoming lifelong learners. Scientific reflective thinking is what characterizes reflective teachers. Teachers who apply scientific principles in teaching are a product of scientific research. Thus, the knowledge of the instructors in scientific research has great implications for teaching.

This study aims to assess the level of knowledge of the Science Instructors in conducting scientific research and determine its implications for their teaching methodology used. The assessment of Instructors' knowledge in conducting scientific research is important to determine their capability in conducting research. This will also be vital in determining the translation process of using research reports in teaching and assessment methodology. The results of the study will also be beneficial to educators teaching in science education because they can identify the implications of conducting scientific research in teaching. Further, administrators of science education can use the results of the study to plan for the improvement of instructors' knowledge in research and plans to utilize this in teaching and assessment methodology.

Research on science teaching and learning plays an important role in helping all students become proficient in science education[2]–[4]. This also helps instructors equipped with information on the latest strategies for science teaching[5], [6] and assessment

methods[7]–[9]. Research can help teachers what works and why, what the short and long-term implications are, provide a justification and rationale for decisions and actions, help to build a repertoire to help deal with the unexpected, identify problems, inform improvement, and so forth [10].
Research is embedded into initial teacher education because as research is embedded into the teacher's practice it can gain a range of benefits. It will help find solutions to problems arising in the classroom or school. Research underpins professional learning of knowledge, skills, and understanding. It connects the teachers to information and networks for professional support. It clarifies purposes, processes, and priorities when introducing change for example to curriculum, instruction, or assessment. It improves understanding of the teacher's professional and policy context, organizationally, locally, and nationally, enabling the teachers to teach and lead more strategically and effectively. Finally, it will help develop the teacher's institution or agency, influence, self-efficacy, and voice within their school and more widely within the profession (Austin, 2021).

General objectives
To determine the level of knowledge of Science Instructors in conducting scientific research and its implication for teaching

Specific objectives
1. To describe the profile of the Science Instructors according to:
    1.1 age,
    1.2 gender,
    1.3 science course handled
    1.4 years of teaching experience,
    1.4 years of experience conducting scientific research,
2. To assess the level of knowledge of Science Instructors in conducting research according to:
    2.1 Information-seeking skills
    2.2 Research methodology skills
3. To identify the teaching and assessment methods of Science Instructors
4. To determine the implications of conducting scientific research in teaching

II. METHODOLOGY

It's The present study utilized a descriptive research design. This design was utilized to assess the Science Instructors' Level of knowledge in conducting scientific research and teaching methodology. This is also to determine the implications of the instructors' level of knowledge in conducting scientific research and their teaching and assessment methodology.

The population included Science Instructors in the selected schools. Respondents were determined utilizing the set inclusion and exclusion criteria. The total sample included 20 Science Instructors from Centro Escolar University. The samples were chosen using the purposive sampling technique. The total respondents do not represent most of the faculty in CEU but are only representative of the population. Because of the limitation of time, the pandemic, and the online set up the researchers had difficulty obtaining the majority of the responses from the faculty online.

Inclusion criteria:
1. Instructors must be handling science courses for the last 1 year
2. The instructor must be conducting scientific research with at least 2 research papers
3. The instructor must be a full-time faculty of the selected school's

Exclusion criteria:
1. Instructors not handling science courses
2. The instructor not conducting scientific research, or with only 1 research paper
3. Instructor on a part-time basis only
4. The instructor who refused to participate in the study

Respondents who refused to participate in the study or withdraw their participation in the study were excluded from the total respondents of the study.

Ethical Considerations
The research proposal was submitted and approved in the chosen school for the conduct of research on human subjects. Participation in the study is voluntary and the respondents did not receive any financial benefit. The participants have the right to refuse participation or withdraw anytime during the conduct of the study without fear of retribution in terms of money or their employment. For the protection of participants' data privacy, all data was stored in the cloud (Gmail accounts) and accessed only by the researchers involved in the study. The principle of confidentiality and anonymity was safeguarded during the conduct of the study. Respondents'

information was coded to ensure the anonymity of the data. Further, the researcher ensured that none of the participants' names or personal details were included in the report of the study findings.

The research study was conducted at Centro Escolar University, Manila campus. The school was chosen as the setting of the study because it caters to learners enrolled in science education. The accessibility of the setting and the respondents were also considered. The school is also where the researcher is enrolled as a graduate student.

The study utilizes a self-report questionnaire. Using a self-report survey tell more than what the participants know or do, and this delimits the findings. The questionnaire is divided into three parts: (1) participant's demographic profile section, (2) rating scales for the instructor's level of knowledge in conducting scientific research, and (3) rating scales for the teaching methodology used. The demographic profile section asks about the instructors' profile (age, gender, courses handled, year of experience, year of experience in conducting scientific research). The instrument to assess the Instructor's level of knowledge in conducting scientific research is based on the study of Meeran and colleagues Developing an instrument to measure research skills [11]. It measures the sub-variables: Information seeking skills, and Research methodology skills. The Likert scale uses four scores (i.e., 5–strongly agree, 4–agree 3–neither agree nor disagree 2–disagree, 1–strongly disagree). The instrument to describe the instructor's teaching and assessment methods are adapted from the study of Akiri et al. (2021) in their study Teaching and Assessment Methods: STEM Teachers' Perceptions and Implementation. This includes assessment of instructors' teaching and assessment methods. The Likert scale uses four scores (i.e., 4–applies to me to a great extent 3–applies to me to a moderate extent 2–applies to me to some extent 1–does not apply to me

The instrument was reviewed by two experienced educators for clarity, accuracy, content, and face validity. The instruments have undergone reliability tests to determine internal consistency using Cronbach Alpha statistics. A Cronbach alpha statistic of 0.80 was obtained which means that the instruments are reliable for use. The data collection process was conducted online via a Google survey. The Google survey was utilized for the questionnaire. The participants were allowed to ask questions and additional explanations related to the questionnaire contents. Online surveys and interviews were used because of the pandemic and heightened restrictions.

To analyze the research variables, the study used descriptive analysis. Frequency and percentage distribution were used to describe respondents' profiles. Mean scores (M) and standard deviations (SD) to assess the Instructor's level of knowledge in conducting scientific research were used as quantitative analysis, The mean score for each descriptor was interpreted using the following scales: 3.18 to 4.00 (very satisfactory/to a great extent, 2.34 to 3.17 (satisfactory/ applies to me to a moderate extent), 1.51 to 2.33 (Poor)/applies to me to some extent, 0 to 1.50 (Very poor)/ does not apply to me. To determine the implications of the instructor's level of knowledge in conducting scientific research and their teaching and assessment methods,
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III. RESULT AND DISCUSSION

Profile of the Science Instructors

The profile of the respondents is presented in Table 1. Respondents age ranges from 51-55 years old (N=7, 35%), 30-35 years old (N= 5=25%) and 41-45 year old (N=4, 20%). Almost a quarter of the respondents is in the 51-55 years age group. The majority of them are female (N=16=80%), with 16-20 years (N=6, 30%) and 1-5 years (N=6=30%) teaching experience. The majority of them also have only 1-5 years of experience conducting scientific research (N=16, 80%).

The data shows that the instructors are almost old and female. The instructors also have high years of teaching experience compared to fewer years of conducting scientific research.

Table 1 Profile of the Respondents

Profile	Frequency	Percentage
Age		
30-35 years old	5	25%
36-40 years old	2	10%
41-45 years old	4	20%
46-50 years old	1	5%
51-55 years old	7	35%
56-60 years old	1	
Sex		

Male Female	4 16	20% 80%
Years of teaching experience 1-5 years 6-10 years 11-15 years 16-20 years 20 years and above	 6 2 3 6 3	 30% 10% 15% 30% 15%
Years of experience conducting scientific research 1-5 years 6-10 years 11-15 years	 16 2 2	 80% 10% 10%

Level of knowledge of Science Instructors in conducting research

The level of knowledge of science instructors in conducting research is determined by the two independent variables. This includes their knowledge of information-seeking skills and research skills. Tables 2 and 3 show the level of knowledge of science instructors in conducting scientific research.

Table 2: Level of knowledge of Science Instructors in conducting research according to Information seeking skills

Information seeking skills	Mean	SD	Rank	Verbal Interpretation
1. Premeditating the types of information that I need like books, articles, journals, and others.	3.50	0.50	5	Very Satisfactory
2. Awareness that information found in journals is more often checked, edited, and criticized compared to information found in magazines	3.55	0.50	4	Very Satisfactory
3. Awareness that information can be obtained through various means (e.g. electronic media, images, audio, and video).	3.55	0.59	4	Very Satisfactory
4. Awareness that the primary source is the first source (original source) that records work related to the literature	3.60	0.49	2	Very Satisfactory
5. Awareness that the secondary source is the source that discusses the work of others	3.25	0.70	9	Satisfactory
6. Use of other sources besides the library in my institution such as the inter-library loan service	3.30	0.56	8	Satisfactory
7. Identification and looking for synonyms, themes, or keywords that can be used to find information based on my topic.	3.65	0.57	3	Very Satisfactory
8. Finding information by reading general texts like dictionaries or encyclopedia articles to gain more understanding of the terminologies used in my topic	3.55	0.50	4	Very Satisfactory
9. Broadening my search using keywords given that the existing source of information indicates that my topic of research is too narrow	3.40	0.49	6	Satisfactory
10. Use of truncation (or shortcuts) in my search or use of root words to start my search	3.25	0.62	9	Satisfactory
11. Finding a book based on the title given	3.25	0.70	9	Satisfactory
12. Searching according to the field to identify the titles of the materials according to a particular field	3.55	0.59	4	Very Satisfactory
13. Looking at the strategy to find the information again to get exactly what I want if it is not successful the first time.	3.35	0.57	7	Satisfactory
14. Evaluating the writer's expertise to see if he/she is qualified in the written field	3.15	0.65	10	Satisfactory
15. Evaluating the accurateness of the content by reading other sources mentioned by the writer	3.15	0.57	10	Satisfactory
16. Understanding the contextual effect for instance how various	3.40	0.49	6	Satisfactory

cultures, history, and geography can influence the perspective of the information				
17. Realizing that time is a factor that influences the relevance of the information to my topic of research	3.65	0.48	3	Very Satisfactory
18. Confirmation of my understanding of a certain topic by getting an opinion or an expert's view (through individual interviews, email, telephone, and others)	3.55	0.59	4	Very Satisfactory
19. Searching for information by arranging each item systematically	3.35	0.57	7	Satisfactory
20. Adjustment with the various quotation styles used	3.35	0.57	7	Satisfactory
21. Searching for information using a database and storing it on my disk or to email it to my email	3.70	0.56	1	Very Satisfactory
22.Recording quotations in order to seek information	3.35	0.73	7	Satisfactory
23. Writing down the important concepts myself using my own words	3.40	0.49	6	Satisfactory
24. Using the main ideas obtained from the information researched to support my topic	3.50	0.59	5	Very Satisfactory
25. Combining the main ideas from one source or more to form a new idea.	3.30	0.64	8	Satisfactory
26. Constructing my conclusion based on the information gathered	3.55	0.59	4	Very Satisfactory
Average Mean	**3.20**	0.57		Satisfactory

The level of knowledge of science instructors in. terms of information-seeking skills is rated to be satisfactory (M=3.20, SD=0.57) (Table 2). The highest-rated is criterion #21 "Searching for information using a database and storing it on my disk or to email it to my email" (M=3.70, SD=0.56) which is verbally interpreted as very satisfactory. While the lowest rated is criterion 14 "Evaluating the writer's expertise to see if he/she is qualified in the written field" (M=3.15, D =0.65) and 15 "Evaluating the accurateness of the content by reading other sources mentioned by the writer " (M=3.15, SD= 0.57).

The data shows that science instructors have satisfactory knowledge of information-seeking skills and the highest knowledge is the basic searching, gathering, and storage of information or data in disk or email . However, critiquing and validation of information gathered is the lowest rated. Information on the internet is vast and there is a need to determine the source of information if it is valuable or pertinent. Evaluation criteria must include accuracy, authority, objectivity, currency, and coverage. The instructor should determine who is the author and their qualifications and expertise. Gathering information consist of a literature review in which the instructor needs to review the information that is scholarly works. Most databases contain articles of different types.

The information-seeking skills pedagogy knowledge described in the study by Dahlqvist (2021) is defined as the base from which learning activities are enacted, and measurable normative outcomes of learning. Science instructors use information-seeking skills as a basis for their teaching and assessment methodologies[2], [5], [14]–[16].

Table 3: Level of knowledge of Science Instructors in conducting research according to Research methodology skills

Research Methodology skills	Mean	SD	Rank	Verbal Interpretation
1. Ability to plan a research	3.30	0.64	2	Satisfactory
2.Developing a research question	3.40	0.66	1	Satisfactory
3.Searching for a research problem	3.40	0.58	1	Satisfactory
4. Doing a literature review	3.30	0.64	2	Satisfactory
5.Design an experiment study	3.05	0.59	4	Satisfactory
6.Selecting an instrument	3.30	0.56	2	Satisfactory
7.Developing an instrument	2.95	0.59	6	Satisfactory
8. Collecting survey data	3.40	0.58	1	Satisfactory
9. Writing an abstract	3.05	0.59	4	Satisfactory
10. Preparing a manuscript for publication	2.85	0.73	7	Satisfactory
11.Selecting an appropriate research method	3.10	0.77	3	Satisfactory
12. Choosing an appropriate method of analysis of data	3.10	0.77	3	Satisfactory
13. Interpreting the result of a research study	3.00	0.71	5	Satisfactory

Average Mean	**3.17**	0.65		Satisfactory

The level of knowledge of science instructors in conducting research according to research methodology skills is rated as satisfactory (M=3.17, SD=0.65). The highest-rated is criterion # 2 " *Developing a research question*" (M=3.40, SD=0.66), 3 "*Searching for a research problem" (M=3.40, SD=0.58),* and 8 "*Collecting of survey data*" (M=3.40, SD =0.58). The lowest rated is criterion # 7 " *Developing an instrument"*.

The data shows that the instructors have satisfactory knowledge of performing research methodology. They have satisfactory knowledge in developing a question, searching for a problem, and collecting survey data. However, the lowest-rated is their knowledge to develop an instrument.

A practical guide for instrument development and validation was introduced by [17]. He introduces the MEASURE approach to instrument development. This includes **Making** the purpose and rationale clear, **Establishing** an empirical framework, **Articulating** a theoretical blueprint, **Synthesizing** content and scale development, **Using** expert reviewers, **Recruiting** participants, and Evaluating validity and reliability.

The instrument development and validation is a tedious process that allows researchers to use their knowledge of the research problems and methodology. The use of peer reviews in instrument development, and validation is necessary to determine the reliability of instruments.

Teaching and Assessment methods of Science Instructors

The teaching methods used by science instructors are described in Table 4. The majority of them rated demonstrations as the most common method applied to them to a great extent (M=3.60, SD= 0.58). Lecture (M=3.55, SD=0.80), class discussion (M=3.5, SD=0.59) and collaborative classwork (M= 3.55, SD=0.59) comes next. The last rate is the use of experiments as a teaching methodology (M= 3.10, SD=0.77).

The results show that instructors mostly used basic teaching methods such as lectures and classroom discussions. However, the instructors as utilized collaborative classwork which is considered a constructivist approach to teaching. Constructivism is a learning theory that holds that knowledge is best gained through a process of reflection and active construction in mind. The learner must consider the information being taught and - based on past experiences, personal views, and cultural background - construct an interpretation [6], [18].

Table 4: Teaching methods of Science Instructors

Teaching methods	Mean	SD	Rank	Verbal Interpretation
1. Lecture	3.55	0.80	2	Applies to me to a great extent
1.2. presentations	3.40	0.80	4	Applies to me to a moderate extent
1.3 short videos	3.25	0.83	6	Applies to me to a moderate extent
1.4 demonstrations	3.60	0.58	1	Applies to me to a great extent
Collaborative classwork (M= 2. Interactive teaching methods- 2.1Class discussion	3.55	0.59	2	Applies to me to a great extent
2.2Collaborative classwork	3.55	0.59	2	Applies to me to a great extent
2.3computerized learning	3.50	0.59	3	Applies to me to a great extent
3.3. Teaching methods combining formative assessment – also referred to as assessment for learning 3.1 experiments	3.10	0.77	8	Applies to me to a moderate extent
3.2 worksheets	3.30	0.56	5	Applies to me to a moderate extent
3.3 Inquiry-based learning	3.30	0.64	5	Applies to me to a moderate extent
3.4 project-based learning	3.20	0.51	7	Applies to me to a moderate extent
Average Mean	**3.39**	0.66		Applies to me to a moderate extent

The assessment methods used by the science instructors are described in Table 5. The use of standardized tests that include open-ended and closed-ended questions applies to them to a great extent (M= 3.50, SD= 0.59) followed by standardized questions with open-ended questions (M= 3.40, SD=0.58) and standardized questions with closed-ended questions (M= 3.30, SD=0.64). The lowest rated is the use of experiment reports which applies to them to a moderate extent (M= 2.70, SD= 0.71).

The results show that the science instructors used the usual standardized questions with open-ended and closed-ended questions. Experiment report is not common to the instructors because all of them are teaching nursing subjects that do not require the conduct of experiments. Oral tests are seen to be also common in this course where students are used to oral revalida examinations. Oral exams provide many benefits, including assessing the deeper levels of student understanding, providing instant feedback to students, and developing students' oral communication skills (Hazen, 2020).

Table 5: Assessment methods of Science Instructors

Teaching methods	Mean	SD	Rank	Verbal Interpretation
1. Traditional Assessment 1.1 Standardized tests with open-ended and closed-ended questions	3.50	0.59	1	Applies to me to a great extent
1.2 Standardized tests with open-ended questions	3.40	0.58	2	Applies to me to a moderate extent
1.3 Standardized tests with closed-ended questions	3.30	0.64	3	Applies to me to a moderate extent
2. Alternative Assessment 2.1 Experiment report	2.70	0.71	8	Applies to me to a moderate extent
2.2 Project portfolio	2.90	0.54	7	Applies to me to a moderate extent
2.3 Inquiry portfolio	2.95	0.50	6	Applies to me to a moderate extent
2.4 Computerized assessment	3.05	0.59	5	Applies to me to a moderate extent
2.5 Oral tests	3.25	0.77	4	Applies to me to a moderate extent
Average Mean	**3.13**	0.62		Applies to me to a moderate extent

Implications to teaching

The limitations of this study include only 20 participants, thus inferential statistics is not advisable to determine the relationship of variables and determine the implications of the two variables: level of knowledge in conducting research and teaching and assessment methods of the instructors. Thus, descriptive research was only used in this study to describe the variables and determine possible implications for teaching[19].

The instructors have a satisfactory knowledge of the conduct of research but only on a basic process of formulating problems. However, higher knowledge of evaluating, synthesizing, and critiquing information gathered is necessary for them to develop. Further, the instructors are only using basic teaching and assessment methodologies and do not expand more on other strategies.

The information gathered is useful in the application and use of the teaching and assessment methodologies. Therefore, if instructors do not know how to synthesize, and evaluate the information they have gathered they cannot also apply it in the real setting of teaching. This will be true in this study where teachers only know the basics of the research process and teaching and assessment methodologies.

IV. CONCLUSION

Instructors have basic knowledge of conducting scientific research. They have difficulty evaluating and critiquing the validity of the information. The only teaching and assessment methodologies used are also the basic lecture and classroom discussions as well as the use of standardized examinations. Instructors need to attend continuous training in the conduct of the research process so they will have increased knowledge and information on other strategies for the teaching and assessment process. This study is limited only to the participants the study and does not generalize the conclusions to all science teachers.

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The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments.

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