Assessment of Science Teachers Pedagogical and Instructional Competence: Basis for Strategic Plan

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Abstract— To develop a teacher's potential in teaching, the teacher's competence in pedagogy and instructions must be considered and discussed in depth. This study aims to assess the science instructors' knowledge level in conducting scientific research and determine its implications for their teaching methodology. The study is descriptive research to describe teachers' pedagogical and instructional competence. The population consists of 34 science teachers who are conveniently selected. The instrument is adapted from studies related to teachers' competence and was rated as very satisfactory to very poor. The study was conducted online using Google forms. Science teachers in the study have very satisfactory pedagogical and instructional materials. However, there is a need to attend more training in pedagogical models and must consider students learning styles. The study results are only limited to the respondents and do not generalize its conclusions to all science teachers. Further study is recommended to prove these findings.

Keywords— Science teachers, Pedagogical competence, Instructional competence

I. INTRODUCTION

Teachers are educators who have an influence on the learning process and have a big responsibility in accomplishing the goals of national education [1]. Teachers have a strategic contribution in determining student accomplishments, the combination of early cognitive abilities and affective of teachers will affect 65% of the accomplishment of students and if supported by the quality of learning then communication will benefit 90% based on Bloom, 1976. In this case, teachers also influence student achievement. In addition, it is not deniable that to produce students who are ready to compete in the modern-day world, they must be trained by teachers who have ample capability and expertise in following upcoming needs.

Teachers' proficiency in pedagogy and instruction must be taken into consideration and thoroughly explored to maximize their teaching ability. The purpose of this study is to evaluate the scientific research knowledge of science instructors and to discover how such information may affect their teaching strategies. Teachers' competence plays important role in the learners' achievement [2],[3],[4],[5],[6],[7],[8],[9], [10], [11]

To assess the pedagogical and instructional competence of science teachers and recommend a strategic plan to improve science teachers' competence level, specifically:

1. To describe the profile of the Science Teachers according to:
    1.1 age,
    1.2 sex,
    1.3 years of teaching experience,

2. To assess the science teachers' level of pedagogical competence

3. To identify the science teachers' level of instructional competence

4. To identify recommendations necessary to formulate a strategic plan to improve the teacher's competence

To the fullest extent possible, teachers' pedagogical and instructional skills must be considered and extensively investigated. This study aims to assess the scientific research expertise of science educators and determine how this knowledge may impact their instructional approaches.

The study's findings will also be helpful to teachers of science since they will enable them to assess their degree of proficiency and enhance their pedagogical and instructional design and approach. Administrators in charge of scientific education might also make plans to enhance instructional competency using the study's findings.

II.   RELATED WORK

Numerous efforts should be instituted to enhance teacher competency including teachers' instructional competence [12] How good teachers in teaching is dependent on motivation, qualifications, experience, training, talents, and other factors [13]. Teacher competence also varies on the training that teachers follow [2], [6], [14], [15] Teachers must linger to learn, and follow scientific activities such as training, seminars, and workshops to increase their horizons, improve the involvement and apply them in teaching and learning activities conducted by teachers [10]. Intensive training may affect the expertise of teachers in teaching [16]. In addition, teacher training should understand the changes that each teacher has, both about the favored learning activities and the competencies that teachers have developed, so that the training programs delivered are not using only one common method intended correspondingly for all teachers [3], [17]. Provision of training on the use of technology involves teachers efficiently using technology and information applications in the classroom to enhance teacher quality in teaching [18]

Changes in the technological, socioeconomic, and, particularly, information and communication settings have an impact on how lessons are taught in classrooms. As a result, dominating conceptions that were taught gradually evolved into concepts that were learned. The learning results of the learners, particularly in terms of academic accomplishment, reveal the quality of education. These metrics relate to the availability of resources, the professionalism of teachers, and the educational experience. [19].

III.   METHODOLOGY

In the current study, a descriptive research design was used. This methodology was used to evaluate the instructional and pedagogical proficiency of science teachers. Changes in the technological, social, and, particularly, information and communication settings have an impact on how lessons are taught in classrooms.

It also offered suggestions for a tactical plan to raise the instructional proficiency of science educators. As a result, widely accepted teachings gradually evolved into accepted learnings. The level of education is demonstrated by the learners' learning outcomes, particularly in terms of academic performance. These evaluations take into account the materials' accessibility, the instructors' subject-matter knowledge, and the standard of the learning environment.

In this study, the convenience sampling method was applied. The researcher does not have direct access to the target population due to online data collection limitations. As a result, the demographic was chosen based on accessibility, availability, and a recommendation from friends and fellow Graduate School students. Teachers of

science who teach science subjects were among the participants. The total sample included 34 science teachers. The convenience sampling method was used to select the samples. Only the population as a whole, not the majority of science teachers, are represented by the total responders. The researchers had trouble getting majority of the responses from the professors online due to time constraints, the epidemic, and the internet setup..

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

Participation in the study was 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 were stored in the cloud (Gmail accounts) and accessed only by the researchers involved in the study.

The principle of confidentiality and anonymity were 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 was included in the report of the study findings.

The research study was conducted online thru a convenience sampling technique. Respondents of the study were from the referrals and friends of the researchers. The study was conducted online using Gforms which was sent thru social media Facebook messenger or personal emails.
The study utilized 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) the participant's demographic profile section, (2) rating scales for the teacher's level of pedagogical competence, and (3) rating scales for the level of instructional competence. The demographic profile section will ask about the instructors' profile (age, sex, science courses handled, year of teaching experience)

The instrument to assess the teacher's level of pedagogical competence was adapted from the study of Ramlawati [20]. The Likert scale uses four scores (i.e., 4–very satisfactory, 3–satisfactory 2–poor 2–very poor)
The instrument to describe the teacher's level of instructional competence was adapted from the study of Azuelo, et al [19]. The Likert scale uses four scores (i.e., 4–very satisfactory, 3–satisfactory 2–poor 2–very poor)
The instruments were 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. An alpha Cronbach of 0.80 is acquired which means that the instrument is reliable for use.

The data collection processes were conducted online via a Google survey. The Google survey was utilized for the questionnaire. The participants were allowed to ask for questions and additional explanations related to the questionnaire contents. Online surveys and interviews were used because of the pandemic and heightened restrictions.

To analyse 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 teacher's level of pedagogical and instructional competence. The mean score for each descriptor will be interpreted using the following scales: 3.18 to 4.00 (very satisfactory), 2.34 to 3.17 (satisfactory), 1.51 to 2.33 (Poor) 0 to 1.50 (Very poor).

IV. RESULTS AND DISCUSSION

The profile of the science teachers is taken from a diverse population and settings. This is because of the limitation of the online survey and the teachers are selected according to convenience. Table 1 presents the profile of the science teachers according to profile. More than a quarter of the teachers are 26-30 years old (N= 11, 32,35%), more than half are female (n=19, 55.88%) and the majority are with 0-5 years of teaching experience (N= 24, 70.58%).

Table 1: Profile of the Science Teachers (N=34)

Profile	Frequency	Percentage
Age		
20-25	7	20.58
26-30	11	32.35
31-35	7	20.58
36-40	4	11,.76
41-45	2	5.88
50 and above	3	8.82
Sex		
Male	15	44.11
Female	19	55.88
Years of Teaching Experience		
0-5	24	70.58
6-10	4	11.76
11-15	2	5.88
16-20	1	2.94
20 years and above	3	8.82
Total	34	100

The data show that majority of the teachers are new in the teaching profession and just have started their careers as reflected by their age. This means that the population in this study is about the new generation of science teachers or what you called the 21st-century teachers.

The 21st-century teachers are characterized as those who are up to date with technology and are adaptive, lifelong learners, tech-savvy, collaborator forward thinkers, and advocates of the profession [21].

The ability of teachers to manage learning, including the capacity to design a learning program, engage with students or control the learning process, and carry out assessments, is known as pedagogical competence. [22]. Successful teaching relies on in-depth topic knowledge, connecting theory and research to teaching and learning, and employing information and skills simultaneously in a reasonable context. Pedagogical competency is comprised of these knowledge and skill sets. [23].

Table 2 presents the science teachers' level of pedagogical competence. The science teachers' level of competence is very satisfactory (M=3.42, SD= 0.59). The highest rated is criterion # 4 Selection of Learning Resources (M= 3.53, SD=0.56) which is also verbally interpreted as very satisfactory. Following the criteria are formulation of indicators (M= 3.50, SD=0.51), formulation of learning objectives (M=3.47, SD=0.56), learning methods (M=3.32, SD=0.64), selection of learning media (M=3.41, SD=0.61) and selection of learning materials (M= 3.38, SD = 0.55). The lowest rated is learning models (M=3.32, SD=0.64).

Table 2 Science teachers' level of pedagogical competence

Pedagogical competence	Mean	SD	Rank	Verbal Interpretation
1. Formulation of indicators	3.50	0.51	2	Very Satisfactory
2. Formulation of learning objectives	3.47	0.56	3	Very Satisfactory
3. Selection of learning materials	3.38	0.55	6	Very Satisfactory
4. Selection of learning resources	3.53	0.56	1	Very Satisfactory
5. Selection of learning media	3.41	0.61	5	Very Satisfactory
6. Learning models	3.32	0.64	8	Very Satisfactory
7. Learning methods	3.44	0.56	4	Very Satisfactory
8. Learning scenarios based on a scientific approach	3.35	0.65	7	Very Satisfactory
9. Learning assessment plan	3.35	0.65	7	Very Satisfactory
Mean	3.42	0.59		Very Satisfactory

The results show that science teachers are more adapted to selecting learning resources however, the last rated is the selection of learning models. Online learning materials are vastly available on the Internet and teachers can access this anytime. While the ability to use and select learning models requires training and development for teachers. The Next Generation Science Standards (NGSS) focus on students' application of sense-making and problem-solving skills to deepen their understanding of naturally occurring phenomena [24]. The NGSS identifies three dimensions: disciplinary core ideas (DCIs), science and engineering practices (SEPs), and crosscutting concepts (CCCs) for teachers to consider as they design challenging and worthwhile instruction [25].

The competence of the teachers is reflected in the evidence of students' achievements in the course. The essence of an effective teacher lies in the knowledge of the teacher to

foster students learning and the ability to do it. Effective teaching is primarily concerned with setting up learning activities to bring about the type of learning the teachers intend.

Table 3 presents the instructional competence of teachers. The instructional competence is rated as very satisfactory (M=3.38, SD = 0.59). The highest rated criterion is # 6. "Implements procedure for effective use of time and management of materials" (M= 3.50, SD =0.51) which is also verbally interpreted as very satisfactory. This is followed by criterion # 8 "Teaching styles used contains content selection, presentation, reflections and applications" (M= 3.44, SD=0.50), Criterion # 1, "Designs, implements and evaluates teaching materials" (M= 3.41, SD=0.56); # 7 " Facilitates the classroom environment that allows for flexible scheduling and transition times" (M= 3.41, SD=0.61) and #9 "Selects, adapts or modifies core existing curriculum to make it accessible to all students" (M=3.41, SD=0.56).

Table 3: Science teachers' level of instructional competence

Pedagogical competence	Mean	SD	Rank	Verbal Interpretation
1. Designs, implements, and evaluates teaching materials	3.41	0.56	3	Very Satisfactory
2. Facilitates collaborative and consultative with teachers, and support staff to improve teaching and learning	3.32	0.64	5	Very Satisfactory
3. Develops a system for monitoring student progress in the instructional setting	3.32	0.64	5	Very Satisfactory
4. Trains and directs activities of students	3.26	0.62	6	Very Satisfactory
5. Implements and interprets various types of formal and informal assessments as determined by individual student needs	3.35	0.65	4	Very Satisfactory
6. Implements procedure for effective use of time and management of materials	3.50	0.51	1	Very Satisfactory
7. Facilitates the classroom environment that allows for flexible scheduling and transition times	3.41	0.61	3	Very Satisfactory
8. Teaching styles used contains content selection, presentation, reflections, and applications	3.44	0.50	2	Very Satisfactory

Number 4th rank is criterion # 5 ". Implements and interprets various types of formal and informal assessments

as determined by individual student needs" (M=3.35, SD=0.65). Followed by criterion #2 "Facilitates collaborative and consultative with teachers, and support staff to improve teaching and learning and criterion #3 "Develops a system for monitoring student progress in the instructional setting" (M=3.32, SD=0.64). The last rated is criterion # 4 "Trains and directs activities of students" (M=3.26, SD=0.62) which is also verbally interpreted as very satisfactory.

The data shows that the science teachers have very satisfactory instructional competence, especially with the use of learning materials. This result is congruent with the respondents' pedagogical competencies which have the highest rate in the selection of learning materials. Though the teachers have a very satisfactory competence in all the criteria of instructional competence, they rated training and directing students' activities as last.

Teachers must consider the learning styles of students in providing learning activities. Teachers must consider engaging, collaborative activities for students. The 21st-century learners have different capabilities to consider in planning effective teaching. The students have often had a higher level of digital literacy than their teachers and parents. They want to have a say in their education and respond better when their voices are been heard. They demand the freedom to show their creativity. And they collaborate and connect with other very effectively [26].

V.   CONCLUSION and Future Scope

The limitations of the population and findings will negate recommendations to formulate a strategic plan to improve teaching competence. The findings suggested in this study are not sufficient to formulate a strategic plan of action. When assigning learning tasks, teachers must take the students' preferred learning styles into account. Teachers must think about fun, group projects for their students. Planning effective instruction must take into account the various capabilities of learners in the twenty-first century.

The way lessons are taught in schools is impacted by changes in technology, socioeconomics, and, particularly, information and communication contexts. Because of this, dominant ideas that were taught progressively transformed into ideas that were learned. The learners' learning outcomes, especially in terms of academic success, show the level of education. These measurements have to do with the accessibility of materials, the expertise of the instructors, and the quality of the learning environment.

In order to give training programs that are appropriate for all teachers, rather than employing only one common approach, teacher training should be able to recognize the differences between each teacher's preferred learning activities and their acquired competencies.

Science teachers in the study have very satisfactory pedagogical and instructional materials. However, there is a

need to attend more training in pedagogical models and must consider students learning styles. The study results are only limited to the respondents and do not generalize its conclusions to all science teachers. Further study is recommended to prove these findings.

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