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Competence of Filipino Secondary Science Teachers in Developing Self-Learning Modules (SLMs)

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Abstract: Competence of Filipino Secondary Science Teachers in Developing Self-Learning Modules. **Objectives:** This study investigates the competence of Filipino secondary science teachers in developing self-learning modules (SLMs) in terms of intellectual property compliance, learning competencies, instructional design and organization, instructional quality, assessment, and readability. **Methods:** Data were gathered from 68 Filipino teachers using simple random sampling and clustered sampling techniques. To analyze the data, frequency count and percentage, mean and standard deviation, and one–way Analysis of Variance (ANOVA) were utilized. **Findings:** Results revealed that science teachers were highly competent in developing SLMs across all six variables. Furthermore, there was a statistically significant difference in the competence in developing SLMs in terms of intellectual property compliance based on their highest educational attainment and in terms of the aspects of learning competencies, instructional design, and organization, and assessment based on their sex. **Conclusions:** Teachers' competence is essential in improving the quality of performance in the learning process.

Keywords: science education, self-learning modules, teacher's competence

Abstrak: Kompetensi Guru IPA SMA di Filipina dalam Mengembangkan Modul Belajar Mandiri. ***Tujuan:*** *Penelitian ini menyelidiki kompetensi guru IPA SMA di Filipina dalam mengembangkan modul belajar mandiri dalam hal kepatuhan kekayaan intelektual, kompetensi pembelajaran, desain dan pengorganisasian pembelajaran, kualitas pembelajaran, penilaian, dan keterbacaan.* ***Metode:*** *Data dikumpulkan dari 68 guru Filipina menggunakan teknik simple random sampling dan clustered sampling. Untuk menganalisis data, digunakan frekuensi dan persentase, mean dan standar deviasi, dan Analisis Varians satu arah (ANOVA).* ***Temuan:*** *Hasil mengungkapkan bahwa guru sains sangat kompeten dalam mengembangkan SLM di semua enam variabel. Selanjutnya, terdapat perbedaan yang signifikan secara statistik dalam kompetensi pengembangan SLMs dalam hal kepatuhan kekayaan intelektual berdasarkan pencapaian pendidikan tertinggi mereka dan dari aspek kompetensi pembelajaran, desain pembelajaran, dan organisasi, dan penilaian berdasarkan jenis kelamin mereka.* ***Kesimpulan:*** *Kompetensi guru sangat penting dalam meningkatkan kualitas kinerja dalam proses pembelajaran.*

Kata kunci: *pendidikan IPA, modul belajar mandiri, kompetensi guru.*

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INTRODUCTION

The global outbreak of the COVID-19 pandemic has impacted the educational system in the world (ECLAC, 2020; Owusu-Fordjour, 2020; UNESCO, 2020). To restrict the spread and flatten the curve of the disease, lockdown, and stay-at-home techniques have been implemented (Caggiano et al., 2020; Crawford et al., 2020; Sintema, 2020). Basic education is heavily affected as schools, and community learning centers are closed for class physical behavior (Tadeo, 2021). The education sector has had to make numerous emergency adjustments to existing practices (Talidong & Toquero, 2020; Williamson et al., 2020) to continue the provision of educational services. The Philippines has encountered many challenges in delivering basic education where face-to-face classes in schools are compromised due to the prohibition following the General Health and Safety Protocol (Bagood, 2020). More than 1.2 billion students worldwide have been affected by temporary school closures, with more than 28 million students in the Philippines (UNESCO, 2020).

The Department of Education (DepEd) addressed the challenges in basic education through its Basic Education Learning Continuity Plan (BE-LCP) under DepEd Order nos. 007,12, 13, and 14 series 2020 to develop a learning continuity plan, health and safety protocols, and assigned teachers from different country regions to develop contextualized and standardized self-learning modules (SLMs) to facilitate learners in the teaching and learning process. Furthermore, the Department of Education (DepEd) developed the Most Essential Learning Competencies (MELC) to declutter the curriculum and make schooling during the epidemic less stressful (DepEd, 2020a). The MELC-aligned SLMs are the backbone of distance learning, designed to make education accessible to online and offline students, particularly those in remote rural areas without access to the internet (Bayod & Bayod, 2020; DepEd, 2020b).

Self-learning modules (SLMs) are a systematic set of instructions that facilitate learners' mastery of a body of knowledge or a complex process (Maile & Cooper, 2018) and are designed where the learner is free to choose what to learn, how to learn, when to learn and where to learn (Sequeira, 2012). The SLMs' content should incorporate constructivist, inquiry-based, reflective, collaborative, and integrative pedagogical techniques (DepEd, 2019). Several studies were conducted concerning the development of learning modules (Sirisuthi, C., & Chantarasombat, 2021; Suppan et al., 2020) and their effectiveness in the teaching process (Diesta et al., 2021; Kareem et al., 2022; Natividad, 2021). It revealed that SLMs enhanced students' process skills (Sareen, 2021) and allowed students to be better engaged with the content and more actively involved in their learning (Logan et., 2021). However, previous studies only focused on the development and effectiveness SLMs.

In designing the learning modules, teachers should use corresponding policy guidelines that define constructivism as a pedagogical approach to developing students as active constructors of meaningful knowledge. The teacher should also be digitally literate in using technology to create digital learning resources, communicate with learners where there is physical separation, and use appropriate pedagogical and assessment strategies to deliver and support education for learners (Ally, 2019). The researchers wanted to fill in the gap by investigating the competence of science teachers in developing SLMs that will genuinely benefit the betterment of the learning modules. The researchers believed more programs would be proposed that will focus on developing quality SLMs and will address the

challenges and difficulties of science teacher-writers.

Review of Related Literature

Global competence teachers can organize effective pedagogical communication in a multicultural environment; abidance by the rules of pedagogical and professional ethics; proficiency in modern information and communication technologies; understanding of one's belonging to the global community; tolerance, responsibility, initiative, readiness for intercultural dialog; creativity; developed critical and global thinking (Orazbayeva, 2016). Perumal & Maistry (2020) revealed that competence could be attributed to global social and economic developments requiring continuously changing knowledge and skills. The professionalization of educators contributes to the quality of their activities and their status as professionals (Manuel et al., 2017).

Luk³ianchuk et al. (2021) studied the need to improve approaches to the development of professional competence of teachers and insufficient development of theoretical, practical, and scientific-methodological aspects of creating conditions for psychological and pedagogical competence of teachers of vocational education in the system of continuing education. Professionals' knowledge-oriented attitude toward developing their capacity and preparedness to tackle professional challenges effectively and autonomously in a range of scenarios is reflected in the competent approach. Yakhshieva & Sidiqova (2020) highlighted the importance of shaping the competencies of future professionals as reflected in the educational standards of higher education and should have the innovative aspects of the development of professional competence of future teachers (Musurmanov et al., 2020).

Nabila (2016) explored the influence of the pedagogical competence and the professional competence of teachers' performance in social studies and found that teachers have limited pedagogical and professional competence at work. Therefore, it is important not only how the teacher develops his pedagogical competence in the process of professional activity but also how it increases the effectiveness of the student's educational activity (Sergeeva, 2019).

Intellectual Property Compliance

Intellectual Property, as a product of the human brain, could take the form of original, creative, and ingenious ideas with enormous potential for the individual innovator, the company, and the country. Everyone has the right to protect the moral and material interest resulting from any scientific, literacy, or artistic production of which they are the author (United Nations General Assembly, 2015). Intellectual Property Rights (IPRs) are increasingly important in international trade, investment, economic relations, and national growth (Bakshi & Kiran, 2014). Barizah (2017) addressed the present state of this framework considering the region's efforts to harmonize intellectual property (IP) laws, including the goals, core concepts, and some key clauses.

Academic dishonesty and its ramifications have become more complicated. The challenges are exacerbated by the availability of electronic media, the serious consequences of wrongdoing and reporting, and the lack of standard practice (Peña et al., 2005). Plagiarism is defined as the act or instance of using or closely mimicking the language and thinking of another author without permission and representing that author's work as one's own, such as by failing to credit the original author. It is the "wrongful appropriation," "theft and publication," and representation of

another author's "language, thoughts, ideas, or expressions" as one's original work. Plagiarism can be deliberate or careless, as well as unintentional. Plagiarism is a sort of intellectual dishonesty and a breach of journalistic integrity. Fines, suspension, and even expulsion may be enforced as sanctions. This definition encompasses all published and unpublished material, whether in manuscript, print, or electronic form (Laxmi, 2018).

Instructional Design and Organization

When it comes to creating effective content area texts, it is crucial to pay attention to the content design and the instructional organization utilized to highlight important information. The content should be organized to show relationships among information, concepts, rules, and organizational structures at both the lesson and the curricular level (Harniss et al., 1994). Instructional strategies should be organized to highlight, integrate, and apply critical concepts and provide a cumulative review of those concepts across the curriculum. Important skills for instructional designers included a strong educational background in pedagogy and instructional design, project management, and research skills, with technology skills also listed, but as a secondary competency. The designers also identified students and their learning experience as their primary motivation and audience (Kumar & Ritzhaupt, 2017).

Instructional design is a systematic process to develop educational programs and learning experiences. It is reflective and iterative as a design process with various activities related to planning, implementing, and assessing facilitated learning events (Farmer, 2011). The instructional design uses a systematic approach to assess learning needs and goals and diagnose and solve workplace problems (Dick et al., 2009; Fortney & Yamagata-Lynch, 2013). Instructional design professionals create learning experiences to improve learning and performance, using a systematic process to develop personalized learning experiences that support learning outcomes (Brown & Green, 2018; Dick et al., 2009). Still, instructional design is inherently complex (Dick et al., 2009), and managing large, complex instructional design projects can be difficult (Atkinson et al., 2006; Gardner, Bennett et al., 2017). In some cases, poor management of an instructional design project can negatively impact learning outcomes if instructional design projects are not managed effectively (Dick et al., 2009). As work competition increases and work becomes more complex and changes quickly, organizations cannot afford to have failed instructional design projects because the consequences could fail to meet learning needs and adapt to change.

Instructional Quality

The fast rise of the internet as a medium for information exchange, combined with the lack of enforced standards for its content, has resulted in a slew of information quality issues. A key concern is Search Engine technology's incapacity to sift through enormous amounts of questionable content and produce "quality" results in response to a user's query (Knight & Burn, 2005).

According to Rose and Levison (2004), a user's view of what is correct, current, significant, or valuable is influenced by the information they seek and why they seek it. The reality that two information searchers can use the same query to convey different meanings or search goals is one issue that makes developing search engine algorithms that facilitate a searcher's information needs such a difficult proposition. A proposition that would be made immeasurably easier if the search engine could better understand the intent of a query.

Naumann and Rolker's (2000) approach is more complex, using a three-fold assessment for the quality of an information source, according to the subjects, objects, and processes involved in Information Retrieval. The premise of this model is based on two basic assumptions: (1) The Quality of Information is influenced by three factors: the perception of the user, the information itself, and the process of accessing the information and (2) The Information Retrieval process involves three entities: the user, the information, and the retrieval system.

As a result, Hölscher & Strube (2000) underline that finding useful information on the internet may be a time-consuming and irritating endeavor for both novice and expert users. Therefore, we research what sorts of knowledge are relevant for Web-based information seeking and which knowledge structures and techniques are involved in improving Web searching based on a better understanding of user characteristics.

Assessment and Readability

Boud and Soler (2016) emphasized that sustainable assessment has been proposed as an idea that focused on assessment contribution to learning beyond the timescale of a given course. All considerations are the average length of sentences, the number of new words incorporated, and the grammatical complexity of the language employed in a paragraph. Assessment activities must meet both the course's specific and immediate goals and provide a foundation for students to carry out their assessment activities in the future.

Readability criteria are needed for a wide variety of tasks, including selecting appropriate reading materials, effectively communicating technical, medical, and business information to both specialist and non-specialists, creating standardized tests, and teaching writing and communication skills (Bailin & Grafstein, 2016). Zamanian and Heydari (2012) cited that to understand the importance of readability best, it is important to define it. Readability has become the criterion for judging style in technical writing (Selzer, 2019). Kasule (2011) found in his research that awareness of "readability issues will help educators to make effective reading instruction during the critical formative years of school." Hidayatillah & Zainil (2020) emphasized that interest and vocabulary difficulty were the most influencing factors in determining readability level.

The preceding reviews of literature reflect the similarities that provide the researcher with significant information, relevant concepts, and valuable ideas in the conduct of this study. It supports the present study on evaluating the competence of Filipino secondary science teachers in developing SLMs. Studies show similarities in the Alternative Delivery Mode (ADM) learning resource standards in developing SLMs that cater to the variables in terms of intellectual property, compliance, learning competencies, instructional design and organizations, instructional quality, assessment, and readability.

Conceptual Framework of the Study

This study underpinned on the DepEd Order Memorandum Nos. 18 and 89., series of 2020 and on the Seven Pillars of Self Learning by Carré & Pearn (1992) are designed to facilitate teachers in developing SLMs. These aimed to explain interrelated aspects of developing SLMs such as intellectual property compliance, learning competencies, instructional design and organization, instructional quality, assessment, and readability. This conceptual framework traces an organized and structured procedure in realizing and achieving the study's outcome.

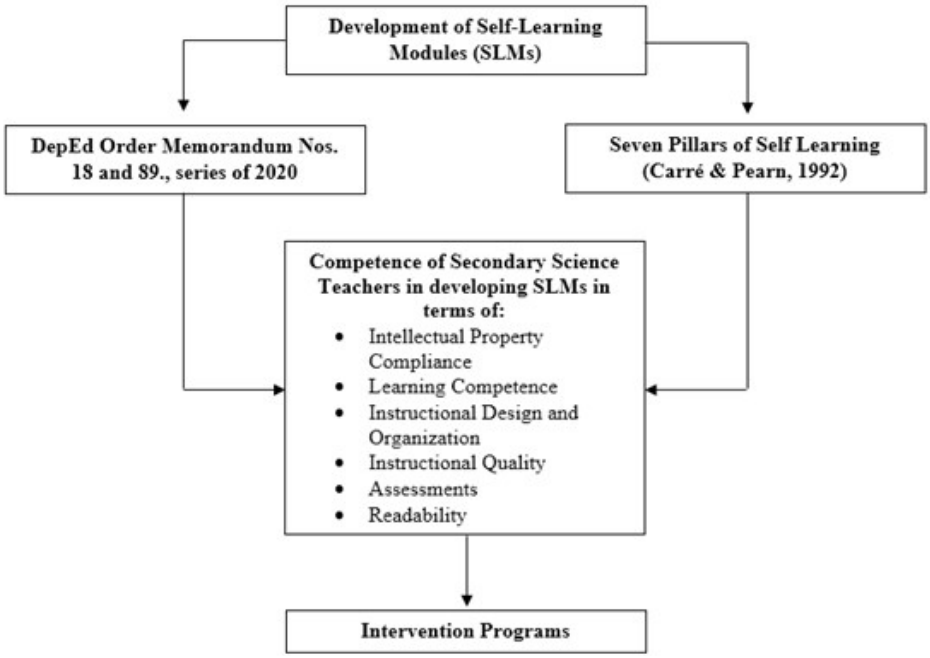

Figure 1. Conceptual framework of the study

Objective of the Study

This study investigates the competence of Filipino secondary science teachers in developing SLMs in terms of intellectual property compliance, learning competencies, instructional design and organization, instructional quality, assessment, and readability. Specifically, it seeks to determine the profile of the respondents and the significant difference in the competence of Filipino secondary science teachers in developing SLMs when grouped according to profile.

METHODS

Participants of the Study

The participants of the study were the Filipino secondary science teacher-writers of SLMs from ten schools of Surigao del Norte Division, Philippines. There were 68 respondents who were selected through simple random sampling and clustered sampling techniques.

Research Design and Procedures

This study was an analytical research design employing a quantitative method. The design is considered appropriate because the study was conducted to deal with the hypothesis testing deemed to determine the significant difference in the competence of secondary science teachers in developing SLMs when grouped according to profile. The survey method was utilized in gathering data.

A certificate from the Office of the Dean of Graduate Studies was secured before the conduct of the study in adherence to the safety and health protocol and data confidentiality from the respondents' answers and identities. Respondents were given with the considerations as to freedom to answer the questionnaire and be part of the delivery of the intervention proposed was indicated in the letter to respondents. Upon the approval, the researcher personally conducted a dry run as refinement of the questionnaires, validity, and reliability of the test with religious adherence to safety and health protocol. After the validation, the distribution of the research instrument to the research teacher-respondents was conducted. The answered questionnaires were collected and checked which respondents'

responses were tallied, treated, and analyzed using the appropriate statistical tools. For confidentiality and anonymity, a code was assigned to each respondent. The hard copies of the gathered data were kept in locked file cabinets while soft copies were stored in password-protected computers.

Instruments

A researcher-made survey questionnaire based on the Alternative Delivery Mode Learning Resource Standards under Regional Memorandum No. 500, s. 2020 was utilized in the study. It composed of two (2) parts. **Part I**: I determined the demographic profile of the respondents in terms of sex, age, highest educational attainment, number of years of teaching science, and relevant training and seminars. **Part II** determined the competence of secondary science teachers in developing SLMs in terms of intellectual property compliance, learning competencies, instructional design and organization, instructional quality, assessment, and readability which consists of thirty (30) items. The scale and descriptions below were utilized to interpret the result of the competence secondary science teachers in developing SLMs (Table 1).

Table 1. Parameter used in the study

Scale	Parameter	Interpretation
4	3.25 – 4.00	Highly Competent
3	2.50 – 3.24	Moderately Competent
2	1.75 – 2.49	Less Competent
1	1.00 – 1.74	Not Competent

The content validity of the instrument was conducted and authenticated by experts and statistician. A criterion-related validation was considered in crafting the research questionnaire to which the responses correlate with an external criterion. With this, a correlation was used to determine if criterion-related validity exists. The crafted questionnaire was submitted to the dissertation adviser for a thorough review and suggestions that were carried out during the revision process. Finally, the revised questionnaire was presented during the proposal defense to the board of panelists. The researcher always followed correct procedure, protocol, scholarly suggestions, and comments of the board of panelists in making the research instrument very valid and concrete as the basis for the distribution to the research participants. To ensure the reliability of the survey questionnaire, Cronbach Alpha was used (Table 2). The survey questionnaire consisted of 5 items in every factor that influences science teachers' competence in developing SLMs.

Data Analysis

Data were treated using descriptive and inferential statistics. Measures of frequency and percentage count were used to describe the variables for the respondents' profiles. Means ± standard deviation (SD) statistical analysis was utilized to evaluate and measure the competence of teachers in developing SLMs as to intellectual property compliance, learning competencies, instructional design and organization, instructional quality, assessment, and readability. In determining the significant difference between the competence of teachers in developing self-learning modules and the profile variables of the respondents, one-way ANOVA was employed where the significance level was set at $p < 0.05$

Table 2. Reliability testing of research instrument divided into six components and their corresponding Cronbach's alpha coefficient and interpretation

Components	No. of Items	Cronbach's alpha	Interpretation*
Intellectual Property	5	0.82	Good
Learning Competencies	5	0.87	Good
Instructional Design and Organization	5	0.89	Good
Instructional Quality	5	0.91	Excellent
Assessment	5	0.85	Good
Readability	5	0.86	Good

**Legend: Below 0.50 (unacceptable); 0.50-0.59 (poor); 0.60-0.69 (questionable); 0.70-0.79 (acceptable); 0.80-0.89 (good); 0.90 and above (excellent)*

■ RESULT AND DISCUSSIONS

Profile of the Respondents

The respondents' demographic profile was presented in Table 1. A total of 68 Filipino secondary science teachers from public schools participated in the study. It can be gleaned that most of the participants were female, and most of their age ranges from 21 to 30 years old. Most of the participants already earned master's degree units in their field of specialization and had been in the service for less than five years.

Table 3. Demographic profile of the respondents

Profile of the Respondents	Respondents		
	Description	f	%
Gender	Male	13	19.12
	Female	55	80.88
Age	21-30	28	41.18
	31-40	21	30.88
	41-50	11	16.18
	51-60	8	11.76
Highest Educational Attainment	Bachelor's Degree Graduate	23	33.82
	MAED unit earner	26	38.24
	Master's degree graduate	8	11.76
	EdD/PhD unit earner	5	7.35
	EdD/PhD graduate	6	8.82
Length of Teaching experiences	0-5 years	44	64.71
	6-10 years	8	11.76
	11-15 years	4	5.88
	16-20 years	5	7.35
	21 years and above	7	10.30

Competence of Filipino Secondary Science Teachers in Developing SLMs

The test outputs of the research participants were evaluated and measured using the parameter of the study to interpret the result of the competence of Filipino secondary science teachers-writers presented in Table 4-9.

Table 4 shows science teachers were highly competent in all indicators (3.86±0.31). This would mean that the science teachers were fully

aware that in developing the SLMs, there is a need to cite all the copyrighted texts and visuals used and that authors of textbooks should be appropriately credited. Findings also indicate that science teacher observed how to avoid plagiarism, and a plagiarism checker is needed that scans billions of sources to discover copied material in assignments and webpages. In the same way, they observed that all the references utilized in developing SLMs are correctly cited in the bibliography.

Intellectual property compliance is an educational necessity in the academic world (Hina et al., 2017). Identifying specific contributions to published work will result in more accurate credit, fewer author disputes, and fewer barriers to collaboration and data and code sharing (Brand et al., 2015). Furthermore, plagiarism checker implementation is essential to reduce academic dishonesty and improve the quality of work, and plagiarism detection software is used to check the originality of work. (Elmunsyah et al., 2018; Sarwar et al., 2016). The information copied from internet resources should be examined using plagiarism detection software (Warn, 2006).

Table 4. Competence of filipino secondary science teachers in developing SLMs inn terms of intellectual property compliance

Intellectual Property Compliance	MeanSD	Interpretation
1. cite all the copyrighted texts used in developing the SLMs.	3.81±0.43	Highly Competent
2. cite all the copyrighted visuals used in developing the SLMs.	3.84±0.41	Highly Competent
3. properly give credits to the authors of the textbooks used in developing SLMs.	3.94±0.24	Highly Competent
4. utilize plagiarism checker application that compares billions of documents to find duplicated text in assignments, websites to avoid plagiarism.	3.91±0.29	Highly Competent
5. properly cite all the references used in developing SLMs in the Bibliography.	3.78±0.59	Highly Competent
Overall	**3.86±0.31**	**Highly Competent**

The competence of Filipino secondary science teachers in terms of learning competencies is presented in Table 5. Respondents were highly competent across five indicators (3.85±0.27). This would mean that the science teachers are fully aware that in developing the SLMs, they must include the DepEd learning competencies, consider specific objectives, align the content of SLMs with the targeted DepEd learning competence and develop SLMs that reinforce, enrich/ or lead to the mastery of the targeted learning competencies intended for the learning area and grade level. Findings also indicate that science teachers followed learners' level of development, needs, and experience in developing SLMs.

These findings were consistent with the study of Care et al. (2018) and Wyse et al. (2016), which claimed that curriculum, pedagogy, and assessment must be aligned to the learning competencies. Teachers were aware of competency-based learning since it focused on outcomes, emphasis on abilities, reduction of focus on time-based training, and promotion of

learner-centeredness (Gruppen et., 2016). Moreover, Harsono (2015) pointed out that teachers are aware of designing learning materials suitable for their student's difficulty levels, needs, and teaching objectives.

Table 6 presents the competence of Filipino secondary science teachers in terms of instructional design and organization. Respondents were highly competent in all five indicators (3.80±00.29). This reveals that science teachers

Table 5. Competence of filipino secondary science teachers in developing SLMs in terms of learning competence

Learning Competence	MeanSD	Interpretation
1. include Department of Education Learning Competencies (LCs) intended for the learning area and grade level.	3.84±0.44	Highly Competent
2. consider specific objectives of the learning area and grade level for which it is intended.	3.90±0.31	Highly Competent
3. follow learner's level of development, needs and experience in developing SLMs.	3.74±0.44	Highly Competent
4. develop SLMs that reinforce, enrich/ or lead to the mastery of the targeted learning competencies intended for the learning area and grade level.	3.88±0.32	Highly Competent
5. align the content of the SLMs with the targeted DepEd learning Competencies intended for the learning area and grade level.	3.91±0.29	Highly Competent
Overall	**3.85±0.27**	**Highly Competent**

are fully aware that there is a need to sequence the contents and activities within each lesson, which facilitates the achievement of objectives and development of classes that allow review, comparison, and integration with previous studies in developing the SLMs. Furthermore, science teachers observed that in developing the SLMs, they should develop and organize content throughout the material. They should provide motivational activities such as overviews and advance organizers, puzzles, and games. Findings also indicate that science teachers used various teaching and learning strategies to meet individual differences and learning styles.

The science of instruction and instructional design models are used to assist the development of instructional design methods that elicit suitable cognitive processes to produce effective learning outcomes (Khalil & Elkhider, 2016). Developing an effective instructional design model to ease the production and delivery of instruction is critical (Chen, 2016). Furthermore, by understanding students' learning styles, teachers will be guided in designing different strategies to help students enhance learning for their improved performance (Cardino & Cruz, 2020). Individual learning needs to be understood by teachers. Individuals interact with their environment during the learning process, uniquely processing information and necessitating a unique learning environment. As a result, addressing the difficulty of facilitating learning circumstances while structuring such encounters should be considered to assist individuals in optimizing their learning (Singh, 2017).

Table 6. Competence of filipino secondary science teachers in developing SLMs in terms of instructional design and organization

Instructional Design and Organization	MeanSD	Interpretation
1. sequence the contents and activities within each lesson which facilitates the achievement of objectives.	3.85±0.36	Highly Competent
2. develop and organize content throughout the material (arranged lessons/activities from simple to complex, from observable to abstract).	3.81±0.40	Highly Competent
3. use various teaching and learning strategies to meet individual differences/ learning styles.	3.69±0.47	Highly Competent
4. provide motivational activities (e.g., overviews, advance organizers, puzzles, games, etc.)	3.78±0.42	Highly Competent
5. develop lessons that allow review, comparison, and integration with previous lessons.	3.85±0.36	Highly Competent
Overall	**3.80±0.29**	**Highly Competent**

As observed in Table 7, science teachers were highly competent in instructional quality (3.82±0.32). This implies that science teachers are fully oriented on the accuracy and factual content and information. The results also indicate that science teachers observed that to avoid error, a grammar checker should be used to ensure that SLMs are free from grammatical error and use up–to–date content and information. In the same manner, they observed that in developing the SLMs, they should be free from computational errors and any social content and violations.

Pit-ten Cate et al. (2019) reported that teachers' judgment accuracy increased in response to high accountability circumstances, but only to a lesser level in response to profile consistency, with inaccuracy reflecting both under- and overestimated student ability. The use of divergent information processing strategies leads to disparities in attention to and processing of information and the quality of judgments and decision-making, particularly under high accountability conditions.

Table 7. Competence of filipino secondary science teachers in developing SLMs in terms of instructional quality

Instructional Quality	MeanSD	Interpretation
1. ensure accuracy and factual content and information.	3.88±0.32	Highly Competent
2. use an up – to -date content and information.	3.78±0.42	Highly Competent
3. ensure that the SLMs are free from any social content violations.	3.85±0.36	Highly Competent
4. ensure that SLMs are free from computational errors.	3.81±0.40	Highly Competent
5. see to it that SLMs are free from grammatical errors.	3.78±0.41	Highly Competent
Overall	**3.82±0.32**	**Highly Competent**

As presented in Table 5, teachers were highly competent in developing SLMs in assessment. This reveals that the science teachers are fully oriented that in developing the SLMs that there is a must to align assessments with the specific objectives, provide "self–checks," ready-made achievements tests, and/ or review activities and give clear demonstrations/examples, instructions, or rubrics to serve as a guide on the assessment outputs. In the same way, they also observed that to ensure active engagement of the learner, a variety of activities was utilized within SLMs, provided with valuable measures and information that help evaluate the learner's progress in mastering the target competencies.

Zhou (2017) mentioned that learning objectives are essential in developing course syllabi and lesson planning. The primary purpose of learning objectives is to explicitly indicate using measurable verbs and phrases what the student must do to demonstrate learning. It is essential to align practice and exams with learning objectives (Crowther et al., 2020). With these, students can solve problems beyond recognizing and reciting specific facts (Songer and Kali 2014).

Table 8. Competence of filipino secondary science teachers in developing SLMs in terms of assessment

Assessment	MeanSD	Interpretation
1. align assessments with the specific objectives.	3.90±0.31	Highly Competent
2. provide "self – checks", ready – made achievement tests, and /or review activities.	3.72±0.51	Highly Competent
3. give clear demonstrations/ examples, instructions, and or rubrics to serve as guide on the assessment outputs.	3.82±0.38	Highly Competent
4. utilize variety of activities within the SLMs to ensure active engagement of the learners.	3.82±0.38	Highly Competent
5. provide useful measures and information that help evaluate learner's progress in mastering the target competencies.	3.76±0.43	Highly Competent
Overall	**3.81±0.33**	**Highly Competent**

The respondents were highly competent in developing SLMs in terms of readability (3.79±0.36). This means that it is essential to give clear instructions on the lessons, exercises, questions, and activities to the target users, while they also observed that in composing paragraphs and sentences, it must be structured to the level of the target learners and observed the length of sentences suit to the comprehension level of the target user. In the same way, science teachers also observed that vocabulary level should adapt to the target user's experience and understanding that provide a logical and smooth flow of ideas within a lesson and from lesson to lesson.

The readability of a piece of text is determined by the difficulty of the words and sentence structure which is the idea that complicated sentences are more difficult to comprehend and read than simpler ones, as reported by Nielsen (2015). Cain and Oakhill (2007) mentioned that sentence-level abilities and processes explaining reading comprehension issues are essential. They reinforced the idea that it would be a mistake to think of a unitary syntax ability as a contributor to reading comprehension. Moreover, one suitable measure of text complexity may not be appropriate at all grade levels and across all content areas (Mesmer et

al., 2020). There should be an adjustment to the influence of sentence length in secondary texts, and word complexity better predicts reading comprehension (Arya et al., 2011).

Table 9. Competence of Filipino Secondary Science Teachers in developing SLMs in terms of Readability

Readability	MeanSD	Interpretation
1. compose paragraphs and sentences that are structured to the level of the target learners.	3.72±0.45	Highly Competent
2. make the length of sentences suit to the comprehension level of the target user.	3.81±0.40	Highly Competent
3. adapt the vocabulary level of the target user's experience and understanding.	3.79±0.41	Highly Competent
4. provide logical and smooth flow of ideas within a lesson and from lesson to lesson.	3.79±0.41	Highly Competent
5. give clear instructions on the lessons, exercises, questions, and activities to the target users.	3.85±0.36	Highly Competent
Overall	**3.79±0.36**	**Highly Competent**

Competence of Filipino Secondary Science Teachers in developing SLMs when grouped according to profile.

The competence of Filipino secondary science teachers in developing SLMs when grouped according to profile is shown in Table 10. Since p-values for learning competencies, instructional design, organization, and assessment are less than 0.05 level of significance, this can be concluded that female and male science teachers statistically significantly differ in their competence in developing SLMs in the aspect of learning competencies, instructional design, and organization, and assessment. However, in terms of intellectual property compliance, instructional quality, and readability, the p-values are greater than the 0.05 level of significance. This indicates that there was no statistically significant difference in the competence in developing SLMs in terms of intellectual property compliance, instructional quality, and readability between female and male science teachers.

Furthermore, when respondents were grouped by age and number of teaching experience, p-values across all constructs in developing SLMs were greater than the 0.05 level of significance. This implies that there was no statistically significant difference in the science teachers' competence in developing SLMs based on age and no of years in teaching science. Findings also showed that there was no significant difference in the competence of the science teachers in developing SLMs in terms of learning competence, instructional design and organization, instructional quality, assessment, and readability when respondents were grouped by highest educational attainment. Meanwhile, there was a statistically significant difference in the level of competence of the science teachers in developing SLMs in terms of intellectual property compliance based on their highest educational attainment.

Table 10. Significant difference of the competence of filipino secondary science teachers in developing SLMs when grouped according to profile.

	Profile	F	p-value	Remarks
Sex	Intellectual Property Compliance	2.21	0.14	Not Significant
	Learning Competencies	***3.89***	***0.05***	***Significant***
	Instructional Design and Organization	***4.83***	***0.03***	***Significant***
	Instructional Quality	1.70	0.20	Not Significant
	Assessment	***4.95***	***0.03***	***Significant***
	Readability	0.17	0.69	Not Significant
Age	Intellectual Property Compliance	0.69	0.60	Not Significant
	Learning Competencies	0.72	0.59	Not Significant
	Instructional Design and Organization	1.43	0.24	Not Significant
	Instructional Quality	1.32	0.27	Not Significant
	Assessment	1.38	0.25	Not Significant
	Readability	2.32	0.07	Not Significant
Highest Educational Attainment	***Intellectual Property Compliance***	***2.54***	***0.04***	***Significant***
	Learning Competencies	2.17	0.08	Not Significant
	Instructional Design and Organization	1.16	0.34	Not Significant
	Instructional Quality	0.55	0.70	Not Significant
	Assessment	1.58	0.19	Not Significant
	Readability	1.23	0.31	Not Significant
Length of Teaching Experience	Intellectual Property Compliance	1.12	0.36	Not Significant
	Learning Competencies	1.42	0.22	Not Significant
	Instructional Design and Organization	0.64	0.70	Not Significant
	Instructional Quality	1.59	0.17	Not Significant
	Assessment	1.38	0.24	Not Significant
	Readability	1.50	0.19	Not Significant

In Figure 4, the error bar of means, the significant mean difference between female and male science teachers in their competence in developing SLMs in learning competencies, instructional design and organization, and assessment. The figure shows that male science teachers have higher competence when it comes to learning competencies, instructional design and organization, and assessment than female science teachers. Besides, the competence of the female

science teachers in the three factors is more varied than the male science teachers, as indicated by the longer blue line segment than the green in the graph.

Recent years have produced many studies about the relationship between teachers' effectiveness and gender. Many researchers, however, have reported the gender of the teacher to be a significant predictor of effectiveness. Kulkarni (2000) found that male teachers were effective, whereas female teachers were average. On the contrary, females were more effective teachers than their male counterparts (Kalita, 2012; Mahanta, 2012; Luschei, 2012). Since the quality of education delivered in general has been considered a function of teachers' degree of effectiveness, Islahi and Nasreen (2013) argued that there is a need for both substantive and methodological focus on gender-specific responsibilities and requirements to get the most out of male and female teachers to produce a high degree of effectiveness in their profession.

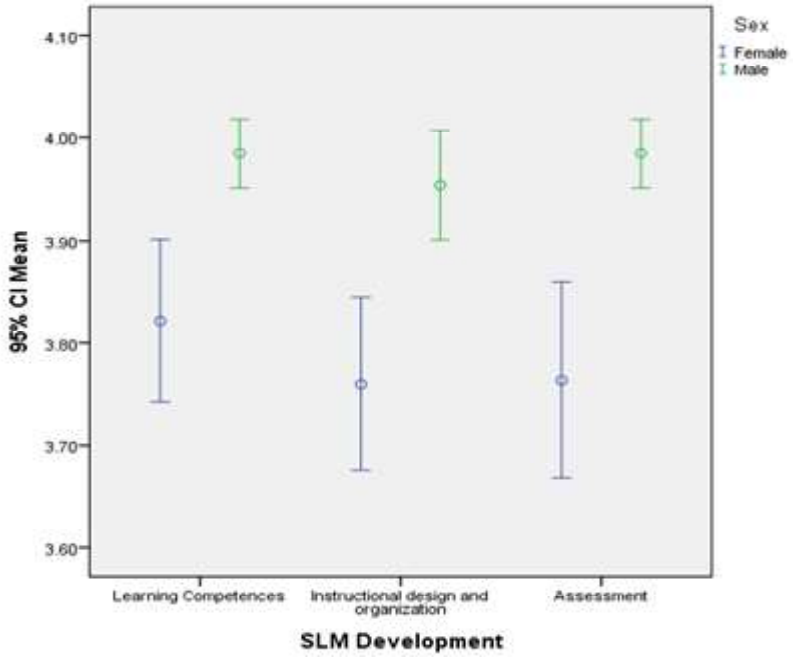

Figure 2. Mean difference by sex in learning competences, instructional design and organization, and assessment

In Figure 5, the error bar of means emphasizes the significant mean difference in the competence in developing SLMs in terms of intellectual property compliance based on the highest educational attainment of the science teachers. It can be gleaned from the results that science teachers with EdD/PhD unit earners and EdD/PhD graduates did not differ significantly in their competence in terms of intellectual property compliance. The teachers who graduated with bachelor's degrees without MAED units and those who graduated with master's degrees did not differ significantly in their competence in terms of intellectual property compliance. The graph also showed that those science teachers who obtained at least EdD/PhD units have the highest competence compared to those with lower educational attainment. Meanwhile, the MAED unit earners group have the least competence in intellectual property compliance among the groups.

Jin et al. (2014) mentioned that intellectual property education cultivates intellectual property professions with mission and justice personalities

and the ability to contribute to society (Maeng & Lee, 2015). Teachers with higher educational attainment have the highest competence in intellectual property compliance. The trend could explain that intellectual property education is the combination of academic education of intellectual property and professional training of intellectual property (Woo, 2014).

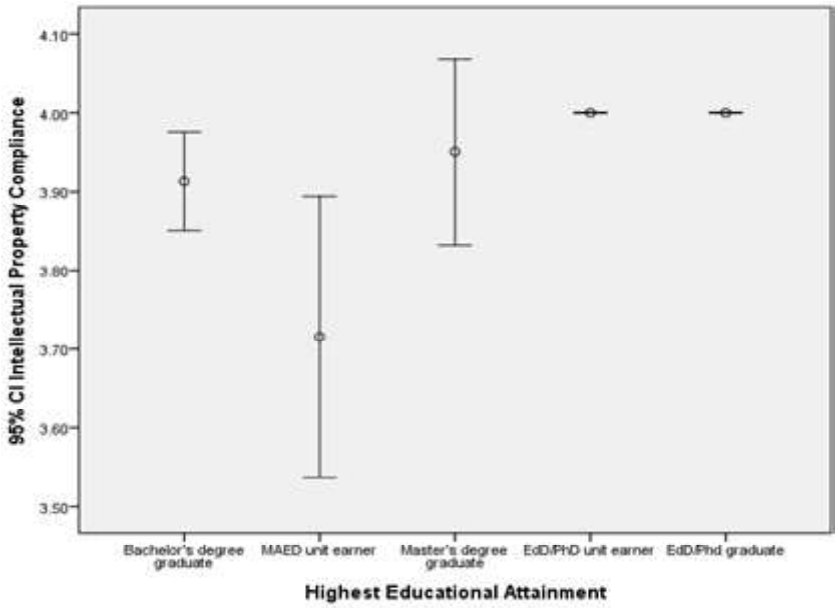

Figure 3. Mean difference in intellectual property compliance based on highest educational attainment

Competence is a significant determinant of intrinsic motivation of the person and actual competence to carry out future tasks (Lindemann-Matthies et al., 2017). The contribution of all the teaching competencies simultaneously or jointly declared significant influences improving the quality of performance in the learning process. Professional competence is the mastery of learning materials in broad and deep, covering the mastery of curriculum content and substance of scientific subjects philosophically. If teachers acquire professional competencies and commitment and are empowered to perform their multiple tasks, high-quality learning among learners may result in cognitive, affective, and psychomotor areas of human development (Hakim, 2015). Moreover, teacher test performance to the overall value-added of teachers also shows a positive relationship (Jackson & Bruegmann, 2009; Clotfelter et al., 2010; Jackson (2012). The importance of teacher quality is the most convincing evidence coming from value-added analysis (Hanushek et al., 2019).

■ CONCLUSIONS

The study is the first to investigate teachers' competence in writing SLMs in the country. Findings revealed that most of the respondents were female, and most of their ages ranged from 21 to 30 years old. Most of the participants already earned master's degree units in their field of specialization and had been in the service for less than five years. Science teachers exhibited high competence across all variables in writing SLMs. Female and male science teachers have different competence of learning competencies, instructional design, organization, and assessments in developing SLMs. Science teachers who obtained the highest educational attainment have the highest competence level compared to those

with lower educational attainment. The study concludes that teachers' competence is essential in improving the quality of performance in the learning process.

The study recommends that school administrators should have the initiative to hire and accommodate male teachers who are a graduate and inclined in science. They should plan and organize relevant training and seminars for the science teacher-writers of SLMs that discuss, focus on, and relate topics in developing quality SLMs. They are encouraged to conduct enhancement workshops and orientation programs to cater to the challenges and difficulties encountered by the science teachers in developing the SLMs. Teachers are encouraged to pursue professional development to master the principle of teaching and learning science. Researchers are encouraged to use the results of this study as a springboard for related research works in the future.

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