

Analysis of the Alignment of K to 12 Most Essential Learning Competencies, Instruction, and Assessment Tools in Statistics and Probability

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Abstract. Curriculum alignment is vital in realizing educational goals. However, predicaments in the teaching and learning process challenge the alignment. Hence, this paper aims to determine students' academic performances in the years 2022-2023 and 2023-2024, analyze the alignment of the curriculum, instruction, and assessment in Statistics and Probability, and propose recommendations to ensure the alignment of curriculum, instruction, and assessment. A document analysis of the teaching and learning tools was conducted to gain in-depth results. Descriptive statistics, such as frequency, percent, mean, and standard deviation, were employed to describe further the results. Results showed that the students' average academic performance in Statistics and Probability for 2022-2023 was 86.80 and 87.46 for 2023-2024, both indicating a very satisfactory level. The teacher's instructions in the six (6) contents of Statistics and Probability were aligned with the curriculum or the K to 12 Most Essential Learning Competencies. Assessment tools were aligned with the teacher's instructions or strategies. The 21st-century skills commonly integrated among learners were critical thinking, information, media, and technology. As the teacher's instructions indicated, students gained an average mastery level (57%). The most common cognitive domain used in the students' assessments was remembering. Findings revealed that the teacher attained good proof of transfer, lesson outlines, and assessments or graded activities aligning curriculum, instruction, and assessment. The teacher obtained an excellent level of objectives. Overall, the teacher aligned the curriculum, instruction, and assessment well. Based on the document analysis, the alignment of teaching and learning resources to the curriculum was evident. This study proposed the following recommendations - implement assessment of standards-based curriculum, effective pedagogy, and achievable assessments, provide teacher support, strengthen evaluation of teaching and assessment, and contextualize assessments catering to the 21st-century skills of the learners.

Keywords: Curriculum alignment; K to 12; Bloom's Taxonomy; Pedagogy; Probability and Statistics.

1.0 Introduction

The curriculum aims to improve learning outcomes, and students' achievement of these objectives is aided by teachers' alignment of their teaching objectives with the instructional activities they participate in. Students must know their places in the curriculum to avoid the adverse effects of misalignment (Alfauzan & Tarchouna, 2017). There are three components in the Alignment Triangle: curriculum, instruction, and assessment. According to

Bunch (2012), these three components are interactive; any of the three can and should inform the other two. For example, in addition to curriculum-driving instruction and assessment, it is also possible that instruction can provide feedback for improving curriculum and refining the format of test items. Similarly, assessment can identify weaknesses in instruction that can be corrected and detect holes in the curriculum that can be filled.

Attaining alignment allows classroom assessments to be included in the curriculum, directing teacher instruction and student learning (Hamstra & Bell, 2019). To encourage student learning, curriculum, instruction, and classroom assessments should all align. However, instructional inconsistencies will occur if the instruction is not geared toward what is intended in the curriculum (Nevenglosky et al., 2018). Similarly, if the assessments are not aligned with the instruction or curriculum, it could undermine students' ability to comprehend the lessons and their motivation to learn. Notwithstanding, the alignment of teaching objectives and assessments can help students grasp what they are learning, uncover key elements of their learning process, and advance the attainment of learning objectives (Zhao et al., 2023). Lastly, based on Meng (2023), effective instructional practices directly contribute to improved student outcomes, and by aligning instructional practices with education quality standards, educators can ensure that their teaching is in line with the desired outcomes and standards of excellence.

One major challenge of the Philippines regarding education is its low rank in international assessments. According to the 2003 Trends in International Mathematics and Science Studies (TIMSS) results, Filipino students struggle to flourish in mathematics and science. Based on the 2022 Programme for International Student Assessment (PISA) study covering 690,000 students from 81 countries, the Philippines' performance in the three subjects "was about the same" as in 2018, when it first took part in the assessment. For the 2022 assessment, the Philippines ranked sixth to the last in reading and mathematics, while science ranked third to the last among 81 countries. This implies that there was no significant improvement in the average scores of Filipino students in reading, mathematics, and science, which remained low compared to students from other countries that participated. As a result, DepEd employed the Enhanced Basic Education Act of 2013, officially known as Republic Act 10533, instructing all instructors to standardize the country's educational system. This status has been the basis for policymakers and implementers who want to change the country's education curriculum. However, it can be deduced that the education sector has undergone a rapid change in curriculum over the years. Results of the study of Choudhary (2023) revealed that curriculum reforms affect students' learning outcomes. On the other hand, keeping the curriculum responsive to changes is necessary to upgrade the quality of education.

The mathematics curriculum in the Philippines underwent several revamps due to the country's low rank in international mathematics assessments. Developing the new mathematics curriculum focuses on critical thinking and problem-solving of learners. However, achieving this goal is not simple, especially when learners are not familiar with the concepts of some areas of mathematics. Statistics and Probability are two core curriculum subjects offered in senior high school. It contains content that helps students become more statistically literate in describing and analyzing data to prepare them for research and future related courses. Thus, investigating the learners' performance in statistics and probability is important to determine the attainment of the curriculum's objectives.

The findings of Kandeel (2019) revealed that students' difficulties in statistics and probability were determined by their weak statistical background and low skills in solving problems involving probability. The study of Dumale and Gurat (2023) disclosed that students have poor retention in statistics and probability as determined by repeated measures ANOVA. Studies have shown that several factors influence students' performance. A study by Retutas & Rubio (2021) was conducted to determine whether there are significant differences between the determinants, gender, type of school, parent's educational level, family monthly income, family size, and Senior High School track preference to students' self-efficacy beliefs, attitudes towards Statistics, and performance in Statistics. The findings revealed that among the demographic factors, only the type of school significantly differs in the self-efficacy beliefs, attitudes towards Statistics, and performance of senior high students in Statistics. According to the multinomial logistic regression model, age, gender, employment status, choice of own study field, getting the right direction, previous academic result, consultation with teachers, father's annual income, family status, and relationship with parents are found to be statistically significant determinants of academic performance (Rahman et al., 2023). Meanwhile, a study by Oliveira Junior et al. (2018) showed that students lack

confidence in solving problems in statistics and probability. These findings suggest that educators reflect on their instructions and assessment tools to undertake remedial measures to improve students' academic performance in statistics and probability.

Curriculum change in the Philippines is predetermined by societal issues and needs, which may be a response to past curriculum reviews and evaluations. In 2013, the Enhanced Basic Education Curriculum was implemented to offer higher-quality education among Filipino learners. Based on the profound analysis of Magno (2011), the Philippines shifted to the K to 12 Curriculum to improve the aims of education, access and progression, teacher-pupil ratio, and medium of instruction while the curriculum described structure, framework, design, duration/time allotment, content, alignment, and assessment. However, de la Fuente (2020) disclosed the challenges faced in the implementation of K to 12, which include the high number of essential learning competencies (LCs) and the challenges it may pose during implementation, along with some issues with the sequencing and expression of the pre-requisites of these learning competencies, weak pedagogy in terms of 21st-century skills, overloaded teaching loads, mismatched student interests, misalignment of learning outcomes and instructional objectives, and so on. The inconsistencies between assessments and instructional activities in the classroom during the K to 12 Curriculum made it difficult for teachers to quickly determine what the students have learned and modify their lesson plans in a way that helps the students truly comprehend the lesson's objectives and apply core literacy.

Curriculum, instruction, and assessment are linked indistinguishably and crucial for an effective teaching and learning process in the Philippines. The alignment of these three foundational principles ensures that students are taught with the necessary knowledge and skills and can demonstrate their academic achievements. It also manifests the quality of teaching and learning in classrooms. Subsequently, Meng (2023) suggests that developing instructional frameworks, fostering a supportive and collaborative school culture, encouraging teacher reflection and self-assessment, and establishing mentorship programs and peer observations underscore the potential of aligning instructional practices with education quality standards. In teaching Statistics and Probability, Mendez (2022) suggests that problem-based learning significantly improves student learning. In line with this, students are more engaged in the learning process and think critically about the concepts of Statistics and Probability. Additionally, Dumale and Gurat (2023) recommend integrating blended and cooperative learning to help students better understand the lessons.

With the above-given information, it is outlined that instructions and assessments are indispensable in guaranteeing student success. Notwithstanding, there is limited research regarding the alignment of curriculum, instruction, and assessment in Statistics and Probability. Thus, the researcher was prompted to investigate the instructional and learning resources in Statistics and Probability. Specifically, this research aimed to 1) determine the academic performances of students in school years 2022-2023 and 2023-2024, 2) determine the alignment of the curriculum (MELCs) and teacher instructions, 3) determine the alignment of teacher's instructions and assessments and the revised Bloom's Taxonomy, 4) analyze the alignment of the curriculum, instruction, and assessment in Statistics and Probability, and 5) propose recommendations to ensure the alignment of curriculum, instruction, and assessment.

2.0 Methodology

2.1 Research Design

This study utilized a qualitative document analysis to review or evaluate the instructional resources and assessments of the teacher in teaching Statistics and Probability. Descriptive statistics, such as frequency and percent, were computed to determine the learners' performances and the curriculum alignment, instruction, and assessment.

2.2 Research Participants

The participants in this study are the students from previous school years and the teacher. There were 65 Grade 11 students involved in this study. Since this research deals with evaluating the instruction and assessments administered by the teacher, the teacher was also counted as a participant.

2.3 Sources of Data

The documents used in this study are the K to 12 Curriculum Guide, Most Essential Learning Competencies (MELCs), teacher's Daily Lesson Logs (DLLs), Quarter Examinations, Table of Specifications (TOS), Written Outputs, Performance Tasks, Item Analysis, and Grade Sheets in Statistics and Probability for the school year 2022-2023. The Most Essential Learning Competencies (MELCs) in the K to 12 Curriculum serve as the learning outcomes of the learners and objectives of the teacher for instruction. Furthermore, the teacher's instructional strategies were gathered from the Daily Lesson Logs (DLLs), while the assessment for the learners was reflected in the Grade Sheets or Teacher's Class Record. The Item Analysis, Table of Specifications, and Quarter Examinations were also used as a reflection for the teacher to improve the instruction and quality of tests. Meanwhile, the content standards and performance standards of statistics and probability were included to further assess the alignment of the curriculum, instruction, and assessment. Additionally, 21st-century skills, as shown in the K to 12 Curriculum Framework, were included in the analysis to better understand the alignment.

2.3 Data Analysis

The academic performances of the learners in Statistics and Probability were calculated using descriptive statistics such as frequency, percent, mean, and standard deviation. To determine the existence of the alignment of the curriculum, instruction, and assessment, the researcher constructed a binary scale (Evident or Not Evident), indicating that the teaching and learning materials are coherent with the curriculum. Moreover, a criterion from La Marca, Redfield, and Winter (2000) was utilized to determine the extent of alignment of the learning assessments, and an alignment rubric comprising the indicators anchored with the K to 12 Curriculum was adopted. Alignment of the curriculum, instruction, and assessment can be measured if the objectives are met, instructional activities are classified, and activities for assessment are present. Furthermore, Bloom's Taxonomy was used as a checklist to ensure that all levels of a domain were assessed. It was also used to evaluate the alignment of assessment methods and instructional methodologies.

2.4 Ethical Considerations

This research strictly followed ethical guidelines. Learners' identities and information were secured and kept confidential following the Data Privacy Act of 2012. Additionally, the researcher only used self-made teaching and learning tools needed for the analyses, and adopted materials in any parts of this paper were given proper references.

3.0 Results and Discussion

3.1 Performance of Students in Statistics and Probability

Descriptive statistics assessed students' academic performance in statistics and probability. Table 1 shows the qualitative description of the students' performances as stipulated in DepEd Order no. 8, s. 2015.

Table 1. Descriptors and grading scale

Descriptor	Grading Scale
Outstanding	90-100
Very Satisfactory	85-89
Satisfactory	80-84
Fairly Satisfactory	75-79
Did Not Meet Expectations	Below 75

Tables 2 and 3 show students' performance in Statistics and Probability for the 3rd and 4th Quarters of the school years 2022-2023 and 2023-2024. Out of 27 students, 12 students (44.44%) performed outstandingly in the 3rd quarter, while 4 students (14.81%) achieved the same level in the 4th quarter. However, in the 4th quarter, many students obtained a very satisfactory level. Students' performance in the 3rd quarter was higher ($m=88.22$, $SD=5.65$) than in the 4th quarter ($m=85.37$, $SD=5.36$). Based on the assessments, as recorded by the teacher, students gained lower scores in the 4th quarter because of low marks in their examinations and activities. However, the decrease in their grade could be described by other factors like classroom disturbances, teacher's strategies, and declined motivation of students to learn.

Table 2. Academic performance of students in Statistics and Probability (2022-2023)

Descriptor	Grading Scale	3 rd Quarter		4 th Quarter	
		f	%	f	%
Outstanding	90-100	12	44.44%	4	14.81%
Very Satisfactory	85-89	10	37.04%	15	55.56%
Satisfactory	80-84	2	7.41%	4	14.81%
Fairly Satisfactory	75-79	3	11.11%	4	14.81%
Did Not Meet Expectations	Below 75	0	0%	0	0%
Mean		88.22 (Very Satisfactory)		85.37 (Very Satisfactory)	

Table 3 presents students' performance in Statistics and Probability during the School Year 2023-2024. Of 44 students, 21 performed outstandingly in the 3rd quarter, while 18 achieved the same level in the 4th quarter. However, in the 4th quarter, two (2) students did not meet expectations because they failed to pass the subject. Failure in the subject indicates students' withdrawal from school, constant absences, and no participation in class. On the other hand, students' performance in the 3rd quarter is higher (m=87.92, SD=4.50) than in the 4th quarter (m=87.00, SD=6.61).

Table 3. Performance of students in Statistics and Probability (2023-2024)

Descriptor	Grading Scale	3 rd Quarter		4 th Quarter	
		f	%	f	%
Outstanding	90-100	21	47.73%	18	40.91%
Very Satisfactory	85-89	15	34.09%	12	27.27%
Satisfactory	80-84	6	13.64%	9	20.45%
Fairly Satisfactory	75-79	2	4.55%	3	6.82%
Did Not Meet Expectations	Below 75	0	0%	2	4.55%
Total		44	100%	44	100%
Mean		87.92 (Very Satisfactory)		87.00 (Very Satisfactory)	

Based on the assessments, as recorded by the teacher, students gained lower scores in the fourth quarter because of low marks in their examinations and activities. However, the decrease in their grade could be described by other factors like classroom disturbances, teacher strategies, and declining motivation of students to learn. Students' grades in the fourth quarter are more dispersed than in the third quarter. Students' mean performance in 2023-2024 is higher than in 2022-2023. However, both groups obtained a very satisfactory level. The performance difference could indicate several factors, such as changes in the teacher's instruction, availability of resources, type of school, and more. The results also represent the teacher's performance in teaching Statistics and Probability.

The findings of Retutas and Rubio (2021) disclosed that the level of student performance in statistics is fairly satisfactory, indicating that most students possess the minimum knowledge, skills, and core understanding of statistics but need help throughout the performance of tasks. Similarly, Mendez (2022) showed that students' pretest performance in Statistics and Probability was average, but their post-test performance was higher due to the interventions administered to the students. Davaatseren, Myagmar, and Dulamsuren (2024) revealed that students' academic performances were affected by their attitudes, family support, socio-economic status, time spent studying and hobbies, career choices, institutional environment, and friends' characteristics. Meanwhile, findings of the study of Ullah and Ahmani (2022) stated that the factors that greatly influenced students' academic performances were insufficient teachers, lack of reading and teaching materials in school, untrained teachers, learning environment, inadequate classrooms, and weak school management.

3.2 Analysis of the Alignment of the Curriculum and Instruction

Table 4 analyzes the alignment of the teacher's instructions and the K to 12 Curriculum Most Essential Learning Competencies. Based on the table, the teacher's instructions or strategies vary by the lessons' content, performance standards, and objectives. Using varied instructions to cater to the learners' interests or learning styles is effective in teaching (Aranda & Zamora, 2016).

Table 4. Alignment of teacher's instructions and the Most Essential Learning Competencies (MELCs) in the K to 12 Curriculum

Content	Content Standards	Performance Standards	Most Essential Learning Competencies The learner...	Instructions/ Strategies	Evident or Not Evident
Random Variables and Probability Distributions	The learner demonstrates an understanding of key concepts of random variables and probability distributions.	The learner can apply an appropriate random variable for a given real-life problem (such as decision-making and games of chance).	1. Illustrates a random variable (discrete and continuous).	Concept Map Picture Analysis Recitation on real-life examples of random variables.	Evident
			2. Distinguishes between a discrete and a continuous random variable.	Lecture Tabular Chart Recitation	Evident
			3. Find the possible values of a random variable.	Lecture Think-Pair-Share Use of Manipulatives	Evident
			4. Illustrates a probability distribution for a discrete random variable and its properties.	Group Activity Exploratory Activity Use of Manipulatives and Worksheets Reporting	Evident
			5. Computes probabilities corresponding to a given random variable.	Lecture Individual Activity (Use of Problem Sets)	Evident
			6. Illustrates the mean and variance of a discrete random variable.	Group Activity Use of Manipulatives and Worksheets Exercises	Evident
			7. Calculates the mean and the variance of a discrete random variable.	Think-Pair-Share Use of contextualized learning material	Evident
			8. Interprets the mean and the variance of a discrete random variable.	Group Activity Exploratory Activity Use of contextualized learning material Worksheets Reporting	Evident
Normal Distribution	The learner demonstrates an understanding of key concepts of normal probability distribution.	The learner can accurately formulate and solve real-life problems in different disciplines involving normal distribution.	9. Solves problems involving mean and variance of probability distributions.	Individual Activity (Use of Problem Sets)	Evident
			10. Illustrates a normal random variable and its characteristics.	Think-Pair-Share Picture Analysis Student practice illustrating a normal random variable	Evident
			11. Identifies regions under the normal curve corresponding to different standard normal values.	Picture Analysis Socratic Method Use of Guided Examples	Evident
			12. Converts a normal random variable to a standard normal variable and vice versa.	Exploratory Activity Use of Worksheets Group Activity Reporting	Evident
			13. Computes probabilities and percentiles using the standard normal table.	Outdoor Activity Game on computing probabilities and percentiles using z-table	Evident
Sampling and Sampling Distributions	The learner demonstrates an understanding of key concepts of sampling and sampling distributions of the sample mean.	The learner can apply suitable sampling and sampling distributions of the sample mean to solve real-life problems in different disciplines.	14. Illustrates random sampling.	Pop-corn Recitation/ Socratic Method Use of technology to show the frequency distribution of learners' responses	Evident

				to the teacher's questions	
			15. Distinguishes between parameter and statistic.	Use of localized/ contextualized material Use of a Venn Diagram	Evident
			16. Identifies sampling distributions of statistics (sample mean).	Group Activity Exploratory Activity Use of Worksheets Exercises	Evident
			17. Finds the mean and variance of the sampling distribution of the sample mean.	Problem-based Design Learning Use of Problem Sets	Evident
			18. Defines the sampling distribution of the sample mean for a normal population when the variance is: (a) known; and (b) unknown.	Think-Pair-Share Use of Concept Organizer	Evident
			19. Illustrates the Central Limit Theorem.	Picture Analysis Group Activity Exploratory Activity Use of Worksheets Exercises	Evident
			20. Defines the sampling distribution of the sample mean using the Central Limit Theorem.	Problem-based Design Learning Popcorn Recitation	Evident
			21. Solves problems involving sampling distributions of the sample mean.	Think-Pair-Share Problem-based Design Learning	Evident
Estimation of Parameters	The learner demonstrates an understanding of key concepts of estimation of population mean and population proportion.	The learner can estimate the population mean and proportion to make sound inferences in real-life problems in different disciplines.	22. Illustrates the t-distribution.	Lecture Picture Analysis Individual Practice on Illustrating T-distribution	Evident
			23. Identifies percentiles using the t-table.	Group Activity Use of t-table Completing the Table (Worksheet) Exercises	Evident
			24. Identifies the length of a confidence interval.	Group Activity Exploratory Activity Use of Worksheets Exercises	Evident
			25. Computes for the length of the confidence interval.	Lecture Individual Activity Use of Worksheets	Evident
			26. Computes for an appropriate sample size using the interval length.	Lecture Use of Problem Sets Cooperative Learning	Evident
Tests of Hypothesis	The learner demonstrates an understanding of key concepts of tests of hypotheses on the population mean and population proportion.	The learner can perform appropriate tests of hypotheses involving the population mean and population proportion to make inferences in real-life problems in different disciplines.	27. Solves problems involving sample size determination.	Guided Learning	Evident
			28. Illustrates: (a) null hypothesis, (b) alternative hypothesis, (c) level of significance, (d) rejection region, and (e) types of errors in hypothesis testing.	Use of Chart Think-Pair-Share Picture Analysis Individual Practice	Evident
			29. Identifies the parameter to be tested given a real-life problem.	Presentation of statistical symbols/ notations Use of localized materials/ examples	Evident
			30. Formulates the appropriate null and alternative hypotheses on a population mean.	Group Activity Exploratory Activity Use of Worksheets Reporting	Evident

Correlation and Regression Analyses	The learner demonstrates an understanding of key concepts of correlation and regression analyses. The learner can perform correlation and regression analyses on real-life problems in different disciplines.	The learner demonstrates an understanding of key concepts of correlation and regression analyses. The learner can perform correlation and regression analyses on real-life problems in different disciplines.	31. Identifies the appropriate form of the test statistic when: (a) the population variance is assumed to be known; (b) the population variance is assumed to be unknown; and (c) the Central Limit Theorem is to be used.	Think-Pair-Share Use of Guided Examples	Evident
			32. Identifies the appropriate rejection region for a given level of significance when: (a) the population variance is assumed to be known; (b) the population variance is assumed to be unknown; and (c) the Central Limit Theorem is to be used.	Lecture Socratic Method Individual Practice	Evident
			33. Computes for the test-statistic value (population mean).	Lecture Use of Problem Sets Cooperative Learning	Evident
			34. Draws a conclusion about the population mean based on the test-statistic value and the rejection region.	Exploratory Activity	Evident
			35. Solves problems involving the test of hypothesis on the population mean.	Lecture Use of Problem Sets Cooperative Learning	Evident
			36. Formulates the appropriate null and alternative hypotheses on a population proportion.	Problem-based Design Learning Popcorn Recitation	Evident
			37. Identifies the appropriate form of the test statistic when the Central Limit Theorem is to be used.	Problem-based Design Learning Think-Pair-Share	Evident
			38. Identifies the appropriate rejection region for a given level of significance when the Central Limit Theorem is to be used.	Exploratory Activity Use of Guided Examples	Evident
			39. Computes for the test-statistic value (population proportion).	Lecture Think-Pair-Share Use of Problem Sets	Evident
			40. Draw a conclusion about the population proportion based on the test-statistic value and the rejection region.	Group Activity Exploratory Activity Use of Worksheets Reporting	Evident
			41. Solves problems involving the test of hypothesis on the population proportion.	Problem-based Design Learning Think-Pair-Share	Evident
			42. Illustrates the nature of bivariate data.	Math Analogy Lecture Socratic Method	Evident
			43. constructs a scatter plot	Group Activity Game-based Instruction	Evident
			44. Describes shape (form), trend (direction), and variation (strength) based on a scatter plot.	Individual Activity Exploratory Activity	Evident
			45. Calculates the Pearson's sample correlation coefficient.	Lecture Think-Pair-Share	Evident
			46. Solves problems involving correlation analysis.	Use of Problem Sets Cooperative Learning	Evident

47.	Identifies the independent and dependent variables.	Group Activity Exploratory Activity Use of Worksheets Reporting	Evident
48.	Calculates the slope and y-intercept of the regression line.	Use of GeoGebra (graphing software) Demonstration teaching	Evident
49.	Interprets the calculated slope and y-intercept of the regression line.	Socratic Method	Evident
50.	Predicts the value of the dependent variable given the value of the independent variable.	Group Activity Exploratory Activity Use of Worksheets	Evident
51.	Solves problems involving regression analysis.	Cooperative Learning	Evident

It can be gleaned from Table 4 that the teacher's instructions in the six (6) contents of Statistics and Probability were evidently aligned with the curriculum or the K to 12 Most Essential Learning Competencies. This finding indicates that the teacher's instructions or strategies were anchored with the objectives of the lessons in the curriculum. It can also be said that before implementing these instructions to the class, the teacher selected appropriate activities for learners to meet the purposes or goals of the lessons in Statistics and Probability.

Yang (2023) studied the curriculum standards and classroom instructional practices which were represented using sets of two-dimensional matrices that comprised content themes and five learning domains: Cognitive, Affective, Psychomotor, Social, and Cultural (the CAPSCt model). The results showed an overall high level of alignment (0.81–0.90) since the intended learning goals covered the said learning domains. Teaching strategies were aligned with the curriculum. However, several factors hinder the delivery of these instructions to the learners (Urbano, 2020). Despite the challenges in teaching, teachers were able to construct materials aligned with the curriculum objectives.

3.3 Analysis of the Alignment of the Instruction and Assessment

Teacher's assessment tools were classified as written outputs and performance tasks. Written outputs comprised of students' formative test scores, worksheets, summative tests or unit quizzes, and problem sets. Furthermore, performance tasks consisted of group reports and individual outputs required by the performance standards of the content of MELCs and these often had greater percentages. Since the teacher's instructions or strategies were aligned with the K to 12 Curriculum Most Essential Learning Competencies (MELCs), the teacher's assessment tools, and their alignment with the teacher's instructions were also analyzed. Table 5 shows the existence of alignment of the teacher's instructions and assessment tools. Moreover, the objectives were categorized according to the learning domains in Revised Bloom's Taxonomy. This enabled the researcher to further assess the cognitive levels required by the curriculum objectives.

Table 5. Alignment of teacher's instructions and assessments and the revised Bloom's Taxonomy

Most Essential Learning Competencies	Learning Domain	Instructions	Assessments		Evident or Not Evident
			Written Output	Performance Task	
1. MELCs 01	Applying	Concept Map Picture Analysis Recitation on real-life examples of random variables.	Formative Test		Evident
2. MELCs 02	Understanding	Lecture Tabular Chart Recitation	Formative Test		Evident
3. MELCs 03	Remembering/ Understanding	Lecture Think-Pair-Share Use of Manipulatives	Formative Test		Evident
4. MELCs 04	Applying	Group Activity Exploratory Activity Use of Manipulatives and Worksheets	Worksheet	Group Report	Evident

5.	MELCs 05	Applying	Reporting Lecture Individual Activity (Use of Problem Sets)	Unit Quiz/ Summative Test	Self-Evaluation	Evident
6.	MELCs 06	Applying	Group Activity Use of Manipulatives and Worksheets	Formative Test		Evident
7.	MELCs 07	Applying	Exercises Think-Pair-Share Use of contextualized learning material	Formative Test		Evident
8.	MELCs 08	Understanding	Group Activity Exploratory Activity Use of contextualized learning material Worksheets	Worksheet	Group Report	Evident
9.	MELCs 09	Applying	Reporting Individual Activity (Use of Problem Sets)	Problem Set		Evident
10.	MELCs 10	Applying	Think-Pair-Share Picture Analysis Student practice illustrating a normal random variable	Unit Quiz/ Summative Test	Mosaic Arts	Evident
11.	MELCs 11	Remembering	Picture Analysis Socratic Method Use of Guided Examples	Formative Test		Evident
12.	MELCs 12	Understanding	Exploratory Activity Use of Worksheets Group Activity	Worksheet	Group Report	Evident
13.	MELCs 13	Applying	Reporting Outdoor Activity Game on computing probabilities and percentiles using z-table	Formative Test		Evident
14.	MELCs 14	Applying	Pop-corn Recitation/ Socratic Method Use of technology to show the frequency distribution of learners' responses to the teacher's questions	Formative Test		Evident
15.	MELCs 15	Understanding	Use of localized/ contextualized material Use of a Venn Diagram	Formative Test		Evident
16.	MELCs 16	Remembering	Group Activity Exploratory Activity Use of Worksheets	Formative Test		Evident
17.	MELCs 17	Applying	Exercises Problem-based Design Learning Use of Problem Sets	Formative Test		Evident
18.	MELCs 18	Remembering	Think-Pair-Share Use of Concept Organizer	Formative Test		Evident
19.	MELCs 19	Applying	Picture Analysis Group Activity Exploratory Activity Use of Worksheets	Formative Test		Evident
20.	MELCs 20	Remembering	Exercises Problem-based Design Learning Popcorn Recitation	Formative Test		Evident
21.	MELCs 21	Applying	Think-Pair-Share Problem-based Design Learning	Unit Quiz/ Summative Test	Journal Writing	Evident
22.	MELCs 22	Applying	Lecture Picture Analysis Individual Practice on Illustrating T-distribution	Formative Test		Evident
23.	MELCs 23	Remembering	Group Activity Use of t-table Completing the Table (Worksheet) Exercises	Formative Test		Evident

24.	MELCs 24	Remembering/ Understanding	Group Activity Exploratory Activity Use of Worksheets Exercises	Formative Test		Evident
25.	MELCs 25	Applying	Lecture Individual Activity Use of Worksheets	Formative Test		Evident
26.	MELCs 26	Applying	Lecture Use of Problem Sets Cooperative Learning	Formative Test		Evident
27.	MELCs 27	Applying	Guided Learning	Unit Quiz/Summative Test		Evident
28.	MELCs 28	Applying	Use of Chart Think-Pair-Share Picture Analysis Individual Practice	Formative Test		Evident
29.	MELCs 29	Remembering/ Understanding	Presentation of statistical symbols/ notations Use of localized materials/ examples	Formative Test		Evident
30.	MELCs 30	Understanding	Group Activity Exploratory Activity Use of Worksheets Reporting	Worksheet	Group Report	Evident
31.	MELCs 31	Remembering/ Understanding	Think-Pair-Share Use of Guided Examples	Unit Quiz/ Summative Test		Evident
32.	MELCs 32	Remembering/ Understanding	Lecture Socratic Method Individual Practice	Formative Test		Evident
33.	MELCs 33	Applying	Lecture Use of Problem Sets Cooperative Learning	Formative Test		Evident
34.	MELCs 34	Analyzing	Exploratory Activity	Formative Test	Drawing Conclusions from Word Problems	Evident
35.	MELCs 35	Applying	Lecture Use of Problem Sets Cooperative Learning	Unit Quiz/ Summative Test		Evident
36.	MELCs 36	Understanding	Problem-based Design Learning Popcorn Recitation	Formative Test		Evident
37.	MELCs 37	Remembering/ Understanding	Problem-based Design Learning Think-Pair-Share	Formative Test		Evident
38.	MELCs 38	Remembering/ Understanding	Exploratory Activity Use of Guided Examples	Formative Test		Evident
39.	MELCs 39	Applying	Lecture Think-Pair-Share Use of Problem Sets	Formative Test		Evident
40.	MELCs 40	Analyzing	Group Activity Exploratory Activity Use of Worksheets Reporting	Worksheet	Group Report	Evident
41.	MELCs 41	Applying	Problem-based Design Learning Think-Pair-Share	Unit Quiz/ Summative Test		Evident
42.	MELCs 42	Applying	Math Analogy Lecture Socratic Method	Formative Test		Evident
43.	MELCs 43	Applying	Group Activity Game-based Instruction	Formative Test	ICT Integration	Evident
44.	MELCs 44	Understanding	Individual Activity Exploratory Activity	Formative Test		Evident
45.	MELCs 45	Applying	Lecture Think-Pair-Share	Formative Test		Evident
46.	MELCs 46	Applying	Use of Problem Sets Cooperative Learning	Unit Quiz/ Summative Test		Evident

47. MELCs 47	Remembering/ Understanding	Group Activity Exploratory Activity Use of Worksheets Reporting	Worksheet	Group Report	Evident
48. MELCs 48	Applying	Use of GeoGebra (graphing software) Demonstration teaching	Formative Test	Developing GeoGebra Skills	Evident
49. MELCs 49	Analyzing	Socratic Method	Formative Test		Evident
50. MELCs 50	Creating	Group Activity Exploratory Activity Use of Worksheets	Worksheet	Essay Writing	Evident
51. MELCs 51	Applying	Cooperative Learning	Unit Quiz/ Summative Test		Evident

It can be gleaned from Table 5 that assessment tools were aligned with the teacher's instructions or strategies. Although the number of performance tasks was less than the written outputs, the teacher made sure that these tasks would cater to the needs of the learners to meet the 21st-century skills and were anchored with the performance standards. Aligned instruction and assessments with the curriculum can improve student performance (Abrams et al., 2016). Subsequently, well-aligned assessments provide valuable insights into student understanding, allowing educators to reflect on the learning outcomes and craft instructional materials to address specific needs and lapses.

In addition, based on the table, the lessons required lower-order thinking skills according to Bloom's Taxonomy. However, the teacher gave assessments not on the same level to allow learners to think deeply about problems in mathematics. Lastly, critical thinking skills were mostly developed among learners in Statistics and Probability. According to Johnson, Boon, and Thompson's (2020) research, there appears to be a particular issue with the way the curriculum's prescribed and implemented cognitive skills line up. The curriculum as provided incorporates cognitive abilities into learning objectives through the use of cognitive verbs like justifying, analyzing, and so on. Educational taxonomies, which facilitate conscious attempts to improve curriculum alignment and aid in the interpretation of the prescribed curriculum, can be used to classify those learning objectives into discrete cognitive categories.

Table 6 presents the distribution of developed 21st-century skills in the instruction and assessments. It was clear that critical thinking was commonly used in learning mathematics. In line with the K to 12 Mathematics Curriculum, critical thinking is one of the skills and attitudes that learners must achieve as they need to correctly assess information and successfully present arguments not just in mathematics, but also in real-life contexts. This also suggests that learners who are encouraged to think critically in mathematics can improve their learning process and be equipped with good decision-making as they relate mathematics to their lives (Sachdeva & Eggen, 2021).

Aside from critical thinking, information, media, and technology were commonly integrated among learners. This indicates that students show satisfaction and interest in learning through active teaching and learning methods that incorporate ICT tools. Moreover, this helps them improve their critical-thinking skills (Pramasdyahsari et al. (2023). Based on these findings, educators are encouraged to foster critical thinking skills in students through inquiry-based learning, real-world applications, collaborative work, and assessment reform (Zhu, 2023).

Table 6. Developed 21st century skills in instruction and assessments

21 st Century Skills	Most Essential Learning Competencies	Frequency	Percent
1. Learning and Innovation			
a. Critical Thinking	1- 51	51	100.00%
b. Creativity	4, 5, 10, 14, 21, 43, 50	7	13.73%
c. Problem-Solving	3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 16, 17, 21, 23, 24, 25, 26, 27, 30, 32, 33, 34, 35, 37, 38, 39, 40, 41, 43, 44, 45, 46, 47, 48, 49, 50, 51	37	72.55%
d. Collaboration	3, 4, 6, 7, 8, 10, 12, 13, 16, 18, 19, 21, 23, 24, 26, 30, 31, 33, 35, 37, 39, 40, 41, 43, 45, 46, 47, 50, 51	29	56.86%
2. Information, Media, and Technology	1-51	51	100.00%
3. Communication Skills	4, 21, 30	3	5.88%
4. Life and Career	5, 50	2	3.92%

Table 7. Student Outcomes in the Alignment of Instruction and Assessment

MELCs	Mastery Level	Description	Evident or Not Evident
MELCs 01	22%	Low	Not Evident
MELCs 02	28%	Low	Not Evident
MELCs 03	72%	Moving Towards Mastery	Evident
MELCs 04	48%	Average	Evident
MELCs 05	26%	Low	Not Evident
MELCs 06	43%	Average	Evident
MELCs 07	30%	Low	Not Evident
MELCs 08	30%	Low	Not Evident
MELCs 09	7%	Very Low	Not Evident
MELCs 10	43%	Average	Evident
MELCs 11	51%	Average	Evident
MELCs 12	67%	Moving Towards Mastery	Evident
MELCs 13	58%	Average	Evident
MELCs 14	81%	Moving Towards Mastery	Evident
MELCs 15	87%	Closely Approximating Mastery	Evident
MELCs 16	83%	Moving Towards Mastery	Evident
MELCs 17	84%	Moving Towards Mastery	Evident
MELCs 18	75%	Moving Towards Mastery	Evident
MELCs 19	72%	Moving Towards Mastery	Evident
MELCs 20	68%	Moving Towards Mastery	Evident
MELCs 21	76%	Moving Towards Mastery	Evident
MELCs 22	74%	Moving Towards Mastery	Evident
MELCs 23	61%	Average	Evident
MELCs 24	78%	Moving Towards Mastery	Evident
MELCs 25	69%	Moving Towards Mastery	Evident
MELCs 26	72%	Moving Towards Mastery	Evident
MELCs 27	50%	Average	Evident
MELCs 28	70%	Moving Towards Mastery	Evident
MELCs 29	54%	Average	Evident
MELCs 30	62%	Average	Evident
MELCs 31	42%	Average	Evident
MELCs 32	40%	Average	Evident
MELCs 33	59%	Average	Evident
MELCs 34	56%	Average	Evident
MELCs 35	70%	Moving Towards Mastery	Evident
MELCs 36	85%	Moving Towards Mastery	Evident
MELCs 37	69%	Moving Towards Mastery	Evident
MELCs 38	35%	Average	Evident
MELCs 39	65%	Average	Evident
MELCs 40	52%	Average	Evident
MELCs 41	33%	Low	Not Evident
MELCs 42	93%	Closely Approximating Mastery	Evident
MELCs 43	52%	Average	Evident
MELCs 44	74%	Moving Towards Mastery	Evident
MELCs 45	61%	Average	Evident
MELCs 46	37%	Average	Evident
MELCs 47	89%	Closely Approximating Mastery	Evident
MELCs 48	24%	Low	Not Evident
MELCs 49	20%	Low	Not Evident
MELCs 50	33%	Low	Not Evident
MELCs 51	91%	Closely Approximating Mastery	Evident
	57%	Average	Evident

Table 7 shows students' mastery of the learning competencies as indicated by the teacher's instructions. It can be gleaned from the table that the students achieved an average mastery of the competencies with 57%, despite having challenges in some learning competencies. Estrellado (2021) studied the analysis of the notable variation in the mastery level when categorized based on preferred learning methods. Using a descriptive survey, results showed that respondents' performance improved from the Pretest Mean of 12.27 and 31.35% MPS to 30.82 as the mean and 75.40% MPS.

Inconsistencies in the alignment of instruction and assessments indicate that the teacher is encouraged to conduct reforms that can increase students' mastery of the learning competencies. This also suggests that the teacher needs

to review the questions of the examination if they target the objectives of the learning competencies. Hence, Figure 1 shows the distribution of items in the 3rd and 4th quarter examinations as categorized using Bloom's Taxonomy.

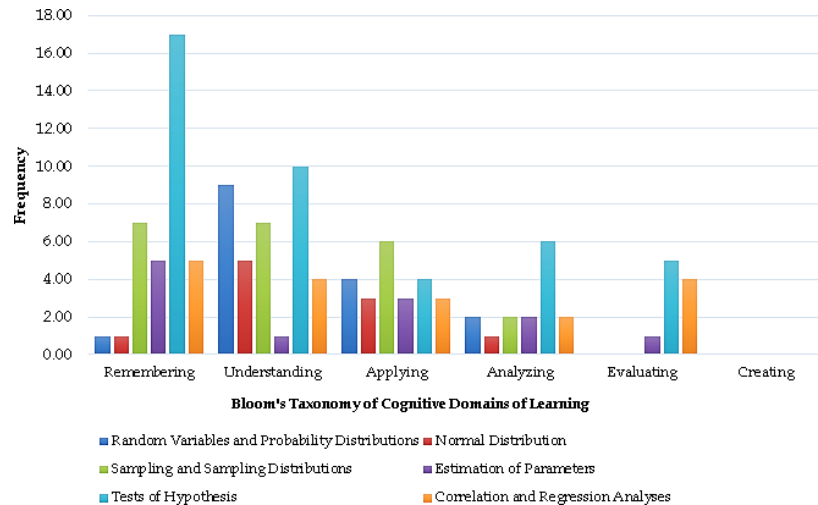


Figure 1. Item Distribution in the 3rd and 4th Quarter Examinations

It can be deduced from the figure that six (6) of the contents of Statistics and Probability have reached lower to higher-order thinking skills. However, the evaluating domain was only covered by the estimation of parameters, the tests of Hypotheses, and correlation and regression analysis. The highest cognitive domain was not covered by any of the contents of Statistics and Probability, while the most common domain was Remembering. This indicates that Statistics and Probability examinations cater to more questions in the lower-order thinking skills. This also suggests that students must improve their higher-order thinking skills, especially in the Evaluating and Creating parts. The study of Saïdo et al. (2015) revealed that students' lower level of cognitive skills was influenced by their learning environment and the nature of the subject curriculum.

3.4 Analysis of the Alignment of the Learning Assessments According to a Criterion

As shown in Table 8, materials used by the teacher in teaching Statistics and Probability are aligned with the indicators in the criterion of La Marca et al. (2000). Worksheets, Summative Tests, Activities or Problem Sets, Quarter Examinations, and Performance Tasks matched with the content, depth, emphasis, performance, and accessibility. This finding implies that despite the number of learning competencies in Statistics and Probability, the teacher constructed assessment tools that allowed students to target the lesson objectives. Appropriate learning assessments evaluate whether students have achieved the learning goals, and matching them with the objectives can better assess their abilities and attitudes towards the subject (Umar, 2018).

Table 8. The extent of alignment of learning assessments, according to La Marca et al. (2000)

Indicators	Materials Used in Statistics and Probability				
	Worksheets	Summative Tests	Activities/ Problem Sets	Quarter Examinations	Performance Tasks
1. Content match	Evident	Evident	Evident	Evident	Evident
2. Depth match	Evident	Evident	Evident	Evident	Evident
3. Emphasis	Evident	Evident	Evident	Evident	Evident
4. Performance match	Evident	Evident	Evident	Evident	Evident
5. Accessibility	Evident	Evident	Evident	Evident	Evident

3.5 Analysis of the Alignment of the Curriculum, Instruction, and Assessment According to Rubric

Table 9 shows the modified alignment rubric for the curriculum, instruction, and assessment.

Table 9. Alignment Rubric			
Criteria	Excellent	Good	Needs Improvement
Proof of Knowledge Transfer	Each course activity or assignment has at least one course-level objective identified for alignment.	Some activities are aligned to course-level objectives.	Most course-level activities or assignments are not identified in the alignment table.
How do you meet your broad, course-level goals? What activities will students complete?	The connection between the activity and objectives is clear.	Some activities do not seem to align well with the identified course-level objectives.	
Lesson Outline	All lessons are listed in order and contain a title. The lessons flow logically.	Some lessons or titles are missing from the outline.	The majority of the lessons are missing from the outline.
How do you envision the course subject path for students?			
Objectives	Each lesson has at least one learning objective associated with it.	Some lessons are missing learning objectives.	The majority of lessons are missing learning objectives.
What is the goal of each lesson? What should students leave each lesson with?			
Assessments and Graded Activities	The assessment descriptions show a clear connection with the lesson's learning objectives.	Some assessments are not aligned with a lesson objective. While identified for alignment with an objective, how the assessment connects with the learning objective is unclear.	The majority of assessments are missing from the lessons. There is not enough assessment information to determine alignment with lesson objectives.
Does your assessment show evidence that students have met the lesson's objective(s)?	Each assessment is tied to at least one objective.		
Resources	Every assessment has a resource aligned to it.	Some assessments do not have resources that align with them.	The majority of lessons are missing learning resources.
Do your resources allow students to complete the aligned assessment?	The alignment between the resource and assessment is clear.	Some of the identified alignments between assessments and resources appear clear.	

Table 10 presents the alignment of the teacher's instructions and assessments with the curriculum according to the above-given rubric, which includes 1) Proof of Knowledge Transfer, 2) Lesson Outline, 3) Objectives, 4) Assessments and Graded Activities, and 5) Resources.

Table 10. Checklist of alignment of the curriculum, instruction, and assessment				
Indicators	Excellent	Good	Needs Improvement	
I. Proof of Knowledge Transfer		✓		
II. Lesson Outline		✓		
III. Objectives	✓			
IV. Assessments and Graded Activities		✓		
V. Resources	✓			

It can be seen in Table 10 that the teacher's instruction and assessment tools are aligned with the curriculum in the following indicators: Proof of Knowledge Transfer, Lesson Outline, Objectives, Assessment and Graded Activities, and Resources. On the other hand, the proof of knowledge transfer obtained a good level. Though each course activity or assignment has at least one course-level objective identified for alignment, some assessments are aligned to course-level objectives, as discussed in Table 8. One reason is that the teacher was new to teaching the subject, and some competencies required a review to be implemented properly in class. Another thing is that the teacher had limited resources in teaching the subject since the school was situated in a remote area where access to the internet was also limited. However, the students' assessment scores support the idea that they still gained knowledge from the teacher. Obtaining a good level in this indicator suggests that the teacher needs to fill the missing gaps to achieve excellent performance in teaching Statistics and Probability.

All lessons are listed in order and flow logically for the lesson outlines, but some are missing from the outline. Thus, the teacher's lesson outline reached a good level. This suggests that lesson outlines are important to keep the discussions flowing smoothly. Admittedly, the teacher did not usually follow the daily lesson log in teaching

the subject since it was more time-consuming. So, the teacher implemented the lesson with strategies parallel to the outline or plan while following the lesson's objectives. Although following the DLL is important, having good lesson outlines indicates that the teacher is prepared to teach the subject.

Since each lesson has at least one learning objective, the objectives of the teacher's instructions and assessments achieved an excellent level. Moreover, though each assessment is tied to at least one objective, some assessments are not aligned with a lesson objective. While identified for alignment with an objective, how the assessment connects with the learning objective is unclear. Hence, assessments and graded activities attained a good level of alignment. Finally, every assessment has a resource aligned to it, and the alignment between the resource and assessment is clear. This indicates that resources obtained an excellent level of alignment. Furthermore, the teacher anchored her assessments to the objectives of the learning competencies, although some lesson objectives were not realized. Furthermore, an excellent level of resources signifies that the teacher ensures that the resources for the lessons are prepared and adequate. However, the assessment or graded activities need additional attention since the teacher's record on the students' assessments reflects low mastery of learners in some of the learning competencies.

4.0 Conclusion

The research findings indicate a positive alignment between curriculum, instruction, and assessment in the Statistics and Probability courses for 2022-2023 and 2023-2024. Key insights highlight that students achieved a consistently high level of academic performance, reflected by satisfactory average scores of 86.80 and 87.46, demonstrating effective teaching strategies and curricular alignment with K to 12 standards. The study shows that teacher instructions and assessment tools were carefully aligned with the curriculum and strategies to develop 21st-century skills, specifically critical thinking and technological literacy. Students achieved an average mastery level of 57%, with a predominant focus on the "remembering" level of Bloom's taxonomy, indicating potential areas for deeper engagement in higher-order thinking skills. The teacher demonstrated strong instructional planning, with high ratings in transfer, lesson outlines, and assessment practices, ensuring that the curriculum, instruction, and assessment were well-coordinated.

Moreover, the alignment of teaching and learning resources with curriculum standards reinforces the overall effectiveness of the instructional approach. However, to enhance student mastery and engagement with complex cognitive tasks, the study recommends a multi-faceted approach: implementing standards-based assessments, fostering effective teaching methods, offering teacher support, strengthening evaluation practices, and contextualizing assessments to promote 21st-century skills further. These findings underline the efficacy of the current educational strategies and provide actionable insights to refine and optimize the alignment of curriculum, instruction, and assessment, thereby supporting continuous improvement in student outcomes and skills development.

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7.0 Conflict of Interests

The author declares that this undertaking has no conflict of interest.

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