

DESIGNING TEACHING SITUATIONS IN PROBABILITY AND STATISTICS TO DEVELOP THE COMPETENCE TO EXPLOIT DATA AND INFORMATION FOR GRADE 10 STUDENTS

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Abstract. In the context of digital transformation and competence-based education, the competence to exploit data and information has become an important requirement for high school students. This paper focuses on proposing the process of designing teaching situations on the topic of Probability and Statistics in the direction of developing the competence to exploit data and information for students. The main research methods used are theoretical research, analysis of the Mathematics curriculum and content, design and illustration with specific teaching situations. On that basis, the paper builds a four-step design process and proposes a number of teaching scenarios associated with practical data. The results of the study contribute to clarifying how to integrate the requirement to develop the competence to exploit data and information into the teaching of Probability and Statistics in high schools.

Keywords: Competence to exploit data and information; teaching situations; probability and statistics; high school students.

1. Introduction

In the context of digital transformation and competence-based education, students' competence in exploiting data and using information has become an inevitable requirement of modern general education (Nguyen & Le, 2021; Tran & Nguyen, 2022). The General Education Program 2018 is oriented to develop students' qualities and capacities, emphasizing the role of mathematical thinking, problem-solving and applying knowledge to practice (Hoang, 2026; Ministry of Education and Training [MOET], 2018a). In particular, with the introduction of Circular 02/2025 of the Ministry of Education and Training, the competence to exploit data and information is identified as an important component of the digital competence structure of high school students (MOET, 2025).

Internationally, the competence to exploit data and information has been examined through related concepts such as data literacy and information literacy. Existing studies have emphasized individuals' ability to search for, evaluate, organize, interpret, and use data to support learning and decision-making processes (Witte et al., 2025; Schreiter et al., 2024). In addition, Lee et al. (2024), through a systematic review of research on teachers' data literacy, identified key dimensions associated with the collection, interpretation, and use of data in educational contexts. Although their study focused on teachers rather than students, it provides a useful conceptual reference for understanding the dimensions of data literacy relevant to educational practice. In Vietnam, several studies have incorporated this competence into digital competence frameworks for students, identifying it as one of the core competencies that should be developed through school subjects, particularly Mathematics (Tran & Do, 2021; Trinh et al., 2024). However,

existing research has mainly focused on describing the structure and components of this competence, while limited attention has been paid to proposing specific processes for designing learning activities or teaching situations to foster the competence to exploit data and information in high school Mathematics education.

On the other hand, the content of Probability – Statistics in the Grade 10 Mathematics program is closely related to practical data and decision-making situations in life, so it is considered a favorable environment for organizing learning activities associated with collecting, processing and analyzing data (MOET, 2018b). Harnessing this potential in the direction of developing the competence to exploit data and information for students is still a problem that needs to be studied systematically.

Stemming from the above bases, this paper aims to propose a process for designing a teaching situation on the topic of Probability – Statistics in the direction of developing the competence to exploit data and information for Grade 10 high school students, and illustrate that process with some specific examples. The new point of the study is the combination of the requirements of Circular 02/2025 on the competence to exploit data and information with the design of Mathematics teaching situations, thereby concretizing the orientation of competence development in teaching Probability – Statistics content.

In terms of research methods, the paper uses document research methods to overview and systematize perspectives related to the competence to exploit data and information and Mathematics teaching situation; analyze the curriculum and content of high school Mathematics to determine the possibility of integrating this competence into the topic of Probability – Statistics; at the same time, apply pedagogical design methods to build processes and illustrated teaching situations.

2. Literature Review

2.1. Competence to exploit data and information

Data literacy, information literacy, and digital competence are related but differ in scope: data literacy focuses on analyzing data, information literacy on searching and evaluating information, and digital competence on the broader use of digital technologies. From this perspective, the competence to exploit data and information is a specific, process-oriented competence emphasizing searching, filtering, evaluating, and using data for learning and decision-making.

Based on the synthesis and adaptation of digital competence frameworks developed by international organizations, particularly UNESCO and the Council of Australian University Librarians (CAUL), Tran and Do (2021) proposed a digital competence framework for Vietnamese students comprising seven competence groups. Among these, “Information and data literacy” is considered a fundamental competence that supports learning, research, and professional development. In the context of high school education, Trinh et al. (2024) also identified “Information and data literacy” as an important competence domain within the digital competence framework for high school students. This domain includes the abilities to browse, search and filter data and information, evaluate data and information, and manage data, information, and digital content.

According to Circular 02/2025 of the Ministry of Education and Training, the competence to exploit data and information in high school students is structured into three component competencies: (1) Browsing, searching and filtering data, information and digital content; (2) Evaluating data, information and digital content; (3) Managing data, information and digital content (MOET, 2025). This approach emphasizes identifying reliable sources of information, organizing data effectively, and using data to support decision-making or problem-solving in the

digital environment, in line with the educational orientation according to the competence-based approach and requirements of the information explosion.

In this study, the competence to exploit data and information is defined as the competence to search, filter, evaluate and manage data, information as well as digital content. These include skills in identifying reliable sources of information, organizing data effectively, and using them to support decision-making or problem-solving in a digital environment.

2.2. Designing teaching situations in the direction of developing students' competence

In the context of educational reform under the General Education Program 2018, the shift from content-oriented teaching to competence-based approach requires fundamental changes in teaching methods (Nguyen & Le, 2021; Hoang, 2026). A teaching situation is understood as an organized learning environment in which teachers design tasks and activities for students to actively solve, thereby acquiring knowledge and achieving learning goals (Le & Nguyen, 2025; Nguyen & Vo, 2025). According to the researchers, a situation only becomes a teaching situation when the teacher puts the content to be conveyed into the events in such a way that it is consistent with pedagogical logic, forcing learners to think, act, and cope to achieve educational goals (Tran & Nguyen, 2022; Nguyen & Le, 2025). The construction of problematic situations not only helps students develop their intellect and practice their skills but also creates an interest and passion for self-discovery of new knowledge (Nguyen & Le, 2021).

For a Mathematics teaching situation to be effective in developing competencies, the design process needs to ensure strict scientific and pedagogical standards. First, the situation must be in line with the goals of the General Education Program in Mathematics 2018, focusing on the formation of core competencies such as problem solving, mathematical thinking and reasoning, or mathematical modeling (Nguyen & Le, 2021; Tran & Nguyen, 2022; Nguyen & Le, 2025). Secondly, the content of the situation should be based on the available knowledge and experience of students to create conditions for them to mobilize old knowledge to solve new problems (Nguyen & Le, 2021; Tran & Nguyen, 2022). Finally, practicality and interdisciplinary connection (such as with Physics and Chemistry) are key factors to help students see the value of mathematics in life, thereby improving their competence to apply knowledge in practice (Tran & Nguyen, 2022; Nguyen & Vo, 2025).

Based on the reviewed sources, a typical Math teaching case design process usually consists of strict steps:

- Step 1: Define the goals and requirements to be achieved. Teachers base on the program to specifically determine the goals of knowledge, competencies and qualities that students need to achieve after the situation (Nguyen & Vo, 2025; Nguyen & Le, 2025; Pham & To, 2025).
- Step 2: Analyze learners and determine background knowledge. Understanding students' expected experiences and difficulties helps teachers design activities that fit and engage (Nguyen & Le, 2025; Pham & To, 2025; Nguyen et al., 2025).
- Step 3: Design learning activities. This is the central step, which usually consists of a sequence of activities: Experience (warm-up) → Forming new knowledge (discovery) → Practice → Practical application (Tran & Nguyen, 2022; Nguyen & Vo, 2025; Nguyen et al., 2025).
- Step 4: Organize the implementation and evaluation. Teachers implement classroom scenarios, observe and adjust based on student feedback to perfect the teaching scenario (Nguyen & Vo, 2025; Nguyen et al., 2025).

An effective teaching situation is usually organized over four key activities to lead students to naturally acquire knowledge. Experiential activities begin by presenting practical problems or close situations to arouse curiosity and the need to solve problems (Nguyen & Le, 2025; Nguyen et al., 2025). This is followed by a knowledge formation activity, where students perform thinking manipulations such as analysis, comparison, generalization to draw new mathematical concepts

or rules (Tran & Nguyen, 2022; Nguyen & Le, 2025). Then, practice activities help students strengthen their skills through similar exercises, practicing their competence to reason closely (Tran & Nguyen, 2022). Finally, application activities provide opportunities for students to solve more complex problems in real life, helping them see the intimate connection between mathematics and natural phenomena or other sciences (Nguyen & Le, 2021; Nguyen & Vo, 2025; Nguyen & Le, 2025).

3. Proposed process for designing teaching situations to develop high school students' competence in exploiting data and information

There have been several previous studies on the process of designing teaching situations to develop student competencies. Building upon the research on the design process for teaching situations conducted by Nguyen et al. (2025), this paper proposes a process for designing a teaching scenario aimed at developing students' competence to exploit data and information as outlined below:

Step 1: Determine the goals of the teaching situation.

In order to determine the goals of knowledge, qualities, and competencies (including the competence to exploit data and information), teachers need to research the content of knowledge to be learned to design appropriate teaching situations. This step contributes to orienting the development of all component competencies, especially helping teachers explicitly identify requirements related to searching, filtering, and evaluating the reliability of data and information in learning tasks.

Step 2: Determine students' prior knowledge of Mathematics and digital competence.

Teachers need to identify the knowledge that students already have to ensure that they can apply that knowledge to solve the situation posed in order to understand new knowledge. At the same time, teachers need to consider the level of digital competence of students, including: The competence to use the Internet to search for information; Skills in using basic digital tools (spreadsheets, charts, data storage); Experience in teamwork and data sharing in a digital environment. This step supports the appropriate selection of tasks corresponding to students' existing abilities in searching and filtering information, as well as their initial capacity to evaluate data reliability when accessing information on the Internet.

Step 3: Develop a teaching situation

On the basis of students' objectives and characteristics, teachers develop teaching situations associated with: Practical contexts that are familiar or meaningful to students; A problem or question needs to be solved with data and information; Data can be collected, processed, or analyzed using appropriate tools. Situations to be ensured: Be practical, create a need to use data; Be open, allowing students to choose how to approach and process data; Create conditions for students to fully perform the operations of data and information exploitation competence. This step plays a central role in creating contexts that require students to actively search, filter, and evaluate the credibility of data from multiple sources. This step directly fosters students' competence to identify relevant information and distinguish between reliable and unreliable data.

Step 4: Design teaching activities.

Based on the specific knowledge content and developed situations, teachers design teaching activities according to the logical sequence of the subject content, focusing on organizing students to: Participate in the process of collecting, processing and analyzing data; Discussing, exchanging and interpreting results based on data; Use data and information to solve the problem posed in the situation. This operationalizes competence development through specific learning tasks, in which students are guided to search for information, filter necessary data, and critically evaluate sources during data collection, processing, and interpretation.

Teaching activities are organized flexibly, in accordance with the characteristics of each knowledge content, which can be combined with individual work, teamwork and the use of digital tools. Through this, students gradually form and develop the competence to exploit data and information in the process of learning Mathematics.

Compared with previous studies focusing mainly on general mathematical competencies, the proposed process explicitly integrates the competence of exploiting data and information into each design step. It embeds requirements for searching, filtering, and evaluating data, links teaching activities with competence components, and emphasizes real-world digital data, thereby providing a practical framework for developing this competence in teaching Probability – Statistics.

4. Illustrative Teaching Situations

4.1. Example 1: Designing a teaching situation on “Range and Interquartile Range (IQR)” to develop students’ competence to exploit data and information

Step 1. Define the objectives of the teaching situation

In terms of knowledge, students are expected to understand the concepts of range and interquartile range (IQR), calculate these measures of dispersion from a dataset, and use them to compare the variability of data in practical contexts. Regarding competencies, the situation contributes to the development of communication and cooperation competencies, mathematical reasoning and communication competencies, as well as the competence to exploit data and information through searching, evaluating, and managing digital data. In addition, the situation aims to foster students’ diligence in collecting and processing data and their responsibility in using information from reliable sources and drawing conclusions based on evidence.

Step 2. Determine students’ prior knowledge.

Before participating in the activity, students are expected to have basic knowledge of datasets, quartiles, and measures of dispersion. They should also be able to read statistical tables, search for information on the Internet, and use spreadsheets such as Excel or Google Sheets to organize and process data.

Step 3. Build teaching situations

The teaching situation is built around a practical problem related to climate characteristics in different regions of Vietnam. The teacher introduces the following situation: *To compare the climate characteristics of Thai Nguyen and Lam Dong provinces, monthly average temperature data can be collected from official meteorological sources. Based on these data, which province exhibits less temperature variation throughout the year?* Students work in groups to search for monthly average temperature data for the two provinces and organize the information in a table similar to Table 1.

Table 1. Structure of the monthly average temperature dataset collected by students

Month	Thai Nguyen ($^{\circ}C$)	Lam Dong ($^{\circ}C$)
January
February
March
...
December

Table 1 presents the structure of the dataset to be completed by students. The actual temperature values are collected from official meteorological sources as part of the learning activity. After completing the dataset, students calculate the range and interquartile range (IQR) for each province. Based on the calculated values, they compare the degree of temperature variation and determine which province exhibits more stable climatic conditions. The situation requires

students not only to perform statistical calculations but also to search for, verify, organize, and interpret data before drawing conclusions.

Step 4. Designing Teaching Activities

The situation provides opportunities for students to develop the competence to exploit data and information through three main activities. First, students identify the information required for the task, search for monthly average temperature data from reliable meteorological sources, and organize the collected information in a spreadsheet. Through this activity, students practice searching, filtering, and managing digital data. Next, students process the collected dataset by calculating the range and interquartile range (IQR) for each province. During this process, they compare information obtained from different sources, check the completeness and consistency of the data, and discuss possible discrepancies. This activity supports the development of students' ability to evaluate and process data before using them for analysis. Finally, students present and discuss their results. Each group explains the meaning of the statistical measures obtained and justifies its conclusions regarding temperature stability in the two provinces. The discussion encourages students to use evidence derived from data rather than subjective opinions and helps them recognize the importance of reliable information sources when making judgments.

Expected outcome

By the end of the activity, students are able to collect and organize data from reliable sources, calculate the range and interquartile range correctly, and use these measures to compare temperature variation between the two provinces. Their conclusions are supported by statistical evidence obtained from the collected data, demonstrating the ability to search for, evaluate, manage, and use information in a meaningful context.

Activity 1: Data Collection and Presentation

The teacher guides students to clarify the type of data to be collected, the time range, the unit of measurement, and the requirement for reliable sources. Each group member searches for the average monthly temperature of Thai Nguyen and Lam Dong in 2025 from meteorological agencies, weather platforms, or official information portals. Students record the data, the unit of measurement, and the source, then enter the information into a personal spreadsheet and share it with the group. This activity develops students' ability to search, filter, present, store, and share digital data systematically.

Activity 2: Data Processing and Statistical Calculation

Groups synthesize the data collected by their members, compare information from different sources, identify discrepancies or missing values, and agree on a common dataset. After checking the dataset for completeness and consistency, students calculate the range and interquartile range for each province. The teacher observes and supports students when necessary, while emphasizing the importance of verifying data before using statistical indicators. This activity develops students' ability to evaluate and process data and to use statistical measures as tools for extracting information from data.

Activity 3: Analyze and discuss the results

After completing the calculations, students discuss the range and interquartile range of the two provinces, analyze the level of temperature fluctuation in each locality, and explain the meaning of the indicators in the practical context. Group representatives present their results and arguments. The teacher asks students to clarify the data basis of their comments and avoid speculative conclusions. Through this activity, students develop the ability to interpret and use data to draw evidence-based conclusions, which is an important manifestation of the competence to exploit data and information.

4.2. Example 2. Designing a teaching situation "Applying Probabilistic Reasoning in Real-world Forecasting" to develop the competence to exploit data and information for high school students

Step 1. Define the goal of the situation

a. Knowledge: Through the situation, students:

- Applying probability concepts and probabilistic reasoning in practical contexts.
- Understand the implications of probability in estimating risk and supporting decision-making.
- Know the relationship between actual forecast data and mathematical probability models.

b. Competence

- General Competencies: communication and cooperation
- Mathematical competence: mathematical thinking and reasoning, mathematical communication.
- Data and information literacy competence, comprising the following component competencies: 1- browsing, searching, and filtering data, information, and digital content; 2- evaluating data, information, and digital content; 3- managing data, information, and digital content.

c. Qualities

- Diligence: actively involved in data collection, processing, and analysis.
- Responsibility: be honest in recording data, have a sense of verifying information and take responsibility for the conclusions made.

Step 2. Determining students' prior knowledge. Before participating in the activity, students are expected to have basic knowledge of probability concepts, including events, sample spaces, and simple probability operations. They should be able to interpret probability values and use probability to describe uncertain situations in everyday life. In addition, students are expected to possess basic skills in searching for information on the Internet, organizing data in spreadsheets such as Excel or Google Sheets, and working collaboratively in a digital environment. These prior experiences provide the foundation for collecting weather forecast data, evaluating information sources, and applying probabilistic reasoning to support decision-making.

Step 3. Building teaching situations

The teaching situation is designed around a practical decision-making task related to weather forecasting. The teacher introduces the following situation: *A student is planning a two-day trip to Ninh Binh and would like to know whether the weather conditions are favorable for the trip. To support this decision, information about the probability of rain can be collected from weather forecasting websites and applications. Based on the available data, how can probability be used to assess the likelihood of having at least one rainless day during the trip?*

Students work in groups to search for rainfall probability forecasts from two or more reputable weather information sources. After comparing the collected information and discussing the reliability of each source, they agree on representative probability values for the two days under consideration. These values are then used to construct a simple probability model for analyzing the travel situation. The task requires students to collect, compare, organize, and interpret information before applying probability concepts to solve a practical problem. In addition to performing calculations, students are encouraged to discuss the reliability of forecast data and the limitations of conclusions drawn from probabilistic models. Through this process, they learn to use data and information as a basis for reasoning and decision-making in real-life contexts.

Step 4. Teaching Activity Design

Activity 1: Data Collection and Evaluation of Information Sources

Students work in groups to collect rainfall probability forecasts for a planned two-day trip to Ninh Binh from two or more reputable weather information sources, such as Weather.com, AccuWeather, Google Weather, or the National Center for Hydro-Meteorological Forecasting.

They record the forecast values, update time, and source of information in a shared spreadsheet. The groups then compare the collected data, identify possible discrepancies among sources, and discuss the reliability of each source based on criteria such as timeliness, consistency, and credibility. Based on this discussion, students agree on representative probability values to be used in subsequent calculations.

Table 2. Rainfall probability data collected from different sources

Date	Source 1	Source 2	Representative value (P)
Day 1	0.40	0.50	0.45
Day 2	0.60	0.70	0.65

The representative value was obtained by averaging the forecast probabilities reported by the selected sources.

Through this activity, students practice searching for, selecting, comparing, and organizing digital information. At the same time, they develop the ability to evaluate the reliability of data sources before using information for analysis and decision-making.

Activity 2: Probability Modeling and Calculation

Students apply the complement rule to calculate the likelihood of having at least one rainless day. For instructional purposes, the rainfall events on the two days are assumed to be independent. This assumption is introduced to simplify the probability model used in the activity. Based on the representative probability values obtained in Activity 1, students construct a simple probability model as follows:

- + Let be the event of rain on Day 1 ($P(A) = 0.45$) and be the event of rain on Day 2 ($P(B) = 0.65$).
- + Assuming independence, the probability of rain on both days is $P(A \cap B) = P(A) \times P(B) = 0.45 \times 0.65 = 0.2925$.
- + The probability of experiencing at least one rainless day is $P = 1 - 0.2925 = 0.7075$ (70.75%).

Through this activity, students use probability concepts to interpret information obtained from weather forecasts and discuss how probabilistic models can support decision-making in practical situations.

Activity 3: Critical Evaluation and Reflection

Students engage in a discussion regarding the model's limitations. They are required to address: What are the limitations of using forecast probabilities to represent real weather conditions?; How does the independence assumption affect the accuracy of the probability model?; Finally, students reflect on how mathematical models serve as approximations of reality, emphasizing the importance of recognizing the constraints of raw data when making informed decisions.

5. Discussion and Conclusions

This study proposes a process for designing teaching situations in the topic of Probability and Statistics with the aim of developing high school students' competence to exploit data and information. Grounded in the principles of competence-based education and the requirements of the 2018 General Education Curriculum, this process provides a pedagogical framework that connects mathematical learning with activities involving the search, evaluation, organization, and use of data. Through this connection, the development of data and information exploitation competence is not treated as a separate objective but is integrated into students' engagement with mathematical content.

The illustrative teaching situations show that Probability and Statistics offer meaningful opportunities for students to work with data derived from practical contexts, interpret statistical information, and make judgments based on evidence. Such learning experiences have the

potential to support the development of mathematical knowledge and skills while creating opportunities for students to use information critically and responsibly in learning and everyday life. In this respect, the study contributes to clarifying how the requirements of Circular No. 02/2025/TT-BGDĐT on digital competence can be translated into concrete teaching practices in Mathematics education.

Nevertheless, the study is limited to theoretical analysis and the design of illustrative teaching situations. The effectiveness of the proposed process in fostering students' competence to exploit data and information has not yet been examined through classroom implementation. Further empirical studies are therefore needed to evaluate their feasibility and educational impact in different teaching contexts.

Notes for contributors: Dr Nguyen Thuy Phuong Tram holds a Phd in Mathematics Education and is affiliated with Dong Thap University, Vietnam. Le Thi Diem Quynh is a lecturer at Thai Nguyen University of Education, Vietnam. Author 1: conceptualization, methodology, writing; author 2: writing, data analysis, review & editing.

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