From Abstraction to Story: AI-Generated Comics for Teaching Probability

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Abstract

Teaching probability in Economics and Business degrees is a well-documented challenge. The core difficulty is not so much the technical complexity of the models themselves, but the gap between what students already know from everyday experience and the abstract notation they are suddenly expected to handle.
This project proposes using AI-generated comic panels as a cognitive bridge between familiar situations and formal probabilistic reasoning. Before introducing each probability model, students are shown a brief visual scene which represents a recognisable economic or everyday situation that embodies the model's logic. This is followed by a guided discussion in which they identify the random element, and only then is the formal model introduced. The sequence, repeated at the start of every thematic block throughout the semester, follows a scene → idea → formalisation structure and is applied in several statistics courses at the University of Oviedo and the University of León. The visual materials are produced using generative AI tools, which makes it feasible to customise them to the economic context of each course and to update them without relying on professional illustration. The paper describes the theoretical basis of the approach, the production and implementation methodology, and the evaluation system planned to assess its impact beyond student satisfaction.
The expected outcomes include fewer errors in model identification, greater willingness to engage with mathematical notation, and improved performance in exam questions related to probability distributions. A teaching protocol summarising the design criteria, implementation steps and evidence-based recommendations will be published at the end of the project to allow other instructors to replicate the methodology in their own quantitative courses.

Keywords: *generative AI, educational comics, probability models, teaching innovation, statistics education.*

1. Introduction

The teaching of statistics in Economics and Business degree programmes faces a persistent challenge: its high level of abstraction. This challenge is particularly acute in advanced courses, where students encounter cognitive barriers that lead to stress and disengagement. In quantitative subjects, interest and perceived value decline over the course of the semester, reinforcing the need for methodologies that stimulate motivation from the outset [11]. Added to this is the fact that probabilistic concepts generate a high cognitive load due to their limited intuitive connection with real-life situations [1]. Many errors stem precisely from the lack of an intuitive representation of the random phenomenon, which underlines the importance of supporting understanding before formalisation.
The literature on economics education highlights that the use of cartoons and comics reduces anxiety and encourages more participatory learning [2]. Comics transform complex theories into visual narratives and trigger a mode of reasoning based on spatial metaphors and graphic sequences [5]. Depicting everyday scenes with humour forces students to link the situation to the concept, promoting higher-order reasoning [9]. In probability, this approach helps to develop intuition: visualising, for example, the logic of a uniform distribution allows one to 'see' the behaviour before encountering the formal notation.
This project proposes using generative artificial intelligence (AI) to create cartoons tailored to the economic and probabilistic context without the need for professional illustration.
The paper is structured as follows. Section 2 reviews the relevant literature. Section 3 describes the project design and implementation methodology. Section 4 discusses the evaluation system and expected results. Section 6 concludes.

2. Theoretical Framework

Teaching probability models at university level involves a dual cognitive demand: students must simultaneously build a mental representation of the random phenomenon and map that representation onto a formal language of notation, parameters and conditions of application. When the first step is missing, the second becomes an exercise in rote memorisation rather than genuine comprehension. Research in statistics education consistently shows that the most common errors in probability tasks are not algebraic mistakes but failures of identification: students cannot recognise what type of random structure a given situation embodies and therefore cannot select or apply the appropriate model [1].

This pattern is consistent with the broader cognitive load framework: abstract notation imposes a high extraneous load that competes with the germane processing needed for understanding. The implication for instruction is that reducing the abstraction barrier at the point of first contact with a model, before formalisation begins, is likely to free cognitive resources and improve comprehension. This is precisely the role that visual and narrative resources can play: not as a substitute for formal content, but as preparation for it. Cladera et al. [11] found that student attitudes towards quantitative subjects deteriorate over the course of the semester, which reinforces the importance of engaging students from the very first contact with each new topic.

Comics and cartoons have a reasonably established place in the educational literature, particularly for subjects where abstraction and student anxiety tend to coincide. Van Wyk [2] showed, in an economics education context, that cartoons reduce anxiety and create more participatory classroom dynamics. The argument is not simply motivational: Groensteen [5] points out that the grammar of comics, the sequencing of panels, the interplay of image and text, and the use of spatial metaphors, activates a form of inferential reasoning that mirrors the logic students need in order to understand probabilistic mechanisms. A well-designed scene prompts the reader to ask what is varying, why, and what the likely outcomes are, which are exactly the questions that make probabilistic reasoning work.

Depicting an everyday situation with a degree of humour or exaggeration forces students to link what they see to the underlying concept, which promotes higher-order reasoning and improves retention [9]. In engineering education, Karimi et al. [4] found that comic-based scientific storytelling facilitates the transfer of technical content and increases motivation among university students. Bestil and Punla [3] demonstrated, in a secondary education setting, that digitised comics specifically designed for probability of random variables improved problem-solving performance and significantly reduced mathematics-related anxiety. Works such as The Cartoon Guide to Statistics [6] have long shown that statistical ideas can be communicated visually without sacrificing rigour, and that accessible presentation does not imply a lower ceiling for understanding.

Despite this evidence, the integration of comics into university-level probability instruction has remained scattered. Most documented cases involve isolated resources rather than a systematic use across a complete course, and none has been designed specifically around a structured sequence of probability models. Martin [10] adds a further relevant consideration: the quality of visual learning materials depends heavily on their design, specifically on whether they have an explicit purpose, avoid ambiguity, and focus attention on a single central idea. This suggests that the effectiveness of comic-based resources is not automatic, but contingent on thoughtful instructional design.

The practical barrier to using customised comics in university teaching has historically been the cost and expertise required to produce them. Generative AI tools, such as ChatGPT, Copilot or Gemini, substantially lower this barrier: they can generate images of reasonable quality from textual descriptions in a matter of minutes, without requiring graphic design skills. Kasneci et al. [7] and the UNESCO guidance on AI in education [8] both acknowledge the potential of these tools for producing flexible, low-cost visual materials at scale, while noting that their effective use depends on instructor judgment in the design and selection of outputs.

Eapen et al. [9] describe a concrete workflow for creating AI-generated educational cartoons: the critical step is writing a precise narrative brief before engaging with the tool. This brief must specify the situation to be depicted, identify the random element clearly, and set the intended tone. The AI handles the illustration; the pedagogical content is determined entirely by the instructor. This distinction is important because it means that generative AI does not replace the instructional design process, it accelerates the production step once that process has been completed. The result is a scalable approach to material creation that was not previously available to standard teaching teams operating without dedicated illustration resources.

3. Project Design and Implementation

The project's methodology is based on a structured process that combines the design of visual materials using artificial intelligence, their phased integration into the classroom, and a monitoring system that enables the assessment of their effectiveness and the improvement of the resource for future academic years. The aim is for the illustrations to serve as an intuitive aid that facilitates the understanding of probability models, without replacing the formal content, but rather preparing students for it and making it more accessible.

3.1 Design and Conceptualisation Phase

We begin by identifying the probability models that typically present the greatest difficulty: binomial, geometric, hypergeometric, Poisson, exponential, uniform and normal. For each model, very brief narrative scripts are developed to translate the essence of the probabilistic behaviour into everyday or economic scenarios that are easily recognisable to students. This step is fundamental because it establishes the conceptual 'entry point' that will later allow the visual story to be linked to the mathematical formulation of the model.
In this phase, the quality criteria for the vignettes are also defined: visual clarity, absence of distracting elements, representation of a single central idea, and an accessible tone. These criteria serve as a guide for all subsequent iterations and ensure the aesthetic and pedagogical coherence of the whole.

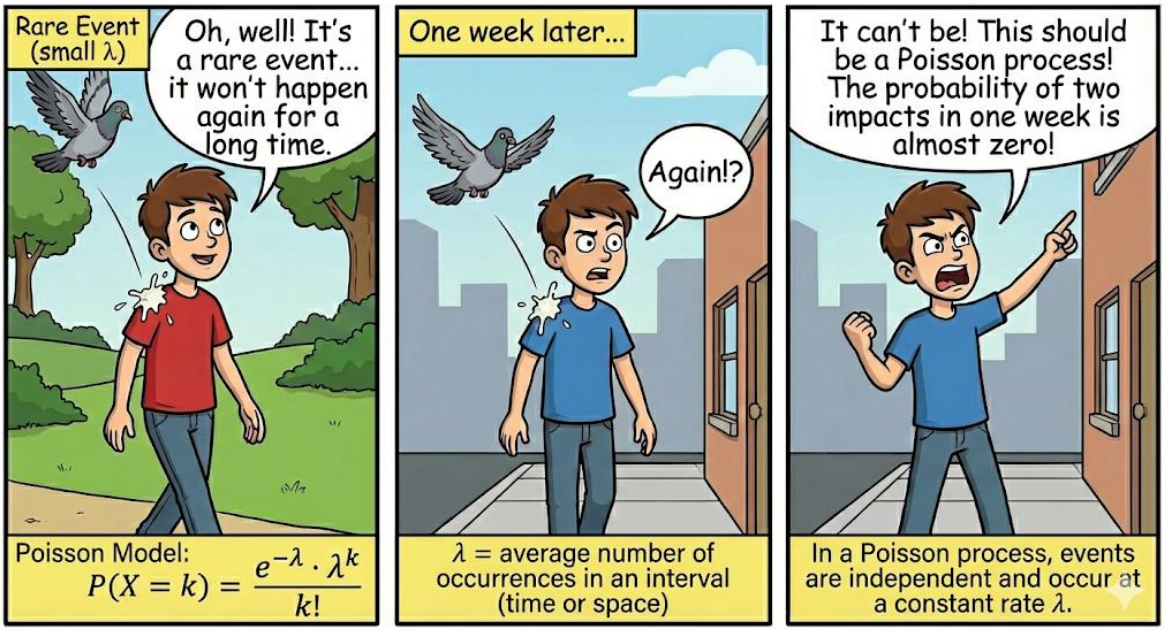
3.2 Generating Content Using AI Tools

Once the scripts have been finalised, we will proceed to create the panels using various generative AI tools (such as ChatGPT, Copilot or Gemini). We will experiment with several platforms to compare graphic styles, clarity, the expressiveness of the scenes and narrative suitability. This comparison is particularly important in an innovation project, as it allows us to make an informed choice as to which tool produces illustrations that are clearer, more comprehensible and more useful for our objectives.

After generating different versions, the team will select the vignettes that best convey the idea associated with each probabilistic model. Aspects such as the balance between detail and simplicity, the ease with which the random element of the scene can be identified, and the extent to which the situation might be recognised by economics and business students will be reviewed. The final result will be a library of vignettes classified by model, reviewed and prepared for implementation in the classroom [Figures 1 & 2].

Fig. 1. AI-generated comic strip illustrating the Geometric distribution: repeated Bernoulli trials until the first success. Source: own elaboration using generative AI (2026).

Fig. 2. AI-generated comic strip illustrating the Poisson distribution: counting the number of events occurring in a fixed interval of time. Source: own elaboration using generative AI (2026).



3.3 Integration into Teaching: A Clear Teaching Routine

The use of the vignettes will follow a consistent and recognisable sequence in the classroom. At the start of each section devoted to a probabilistic model, the lesson will begin with the projection of the relevant vignette. This opening serves to activate prior knowledge, spark curiosity and focus attention on a concrete, relatable example.

This will be followed by a brief guided discussion in which pupils will be invited to identify which element of the scene is random and how the phenomenon might be represented. This intuitive identification facilitates the transition to the formal explanation, which is introduced immediately afterwards. The corresponding model, already covered in the syllabus, will then be presented, and its applications will be explored through practical exercises, tables, calculations or interpretations. This integration allows

for a direct assessment of the usefulness of the vignettes in the initial identification of probabilistic models and in the transition towards formalisation.
The vignette thus acts as a bridge between the everyday and the abstract. Its aim is not to teach the model in itself, but to create a mental framework that allows the formal explanation to be understood with less cognitive effort and a stronger connection to reality.

3.4 Digital Support and USE on the Virtual Campus

After each session, the comic strips will be published on the Virtual Campus, organised by model. Students will be able to access them to revise the topics, reinforce conceptual associations and recall the logic behind each block. This presence on the Virtual Campus makes the cartoon an accessible and reusable resource throughout the semester, serving as a visual aid for independent study and exam preparation. This digital organisation ensures the sustainability of the resource and facilitates its subsequent adaptation to new subjects.

3.5 Monitoring and Data Collection via a Questionnaire

The monitoring of the project will be based on the students' own feedback. To this end, a questionnaire will be created using Google Forms, published on the Virtual Campus and announced in class. The questionnaire will be brief and anonymous, and will include questions on:

– The perceived usefulness of the diagrams in understanding the model before tackling the formal aspects.

– The clarity of the scenes and whether they have helped students connect better with the examples covered in the exercises.

– Suggestions for improvement for future editions (level of detail, length of captions, context of the stories, etc.).

– Preference regarding the format of the cartoons: whether simpler cartoons without formulas are preferred, or cartoons that already incorporate some mathematical elements.

The data will be analysed to identify patterns, opportunities for improvement and possible adjustments to the design of the scenes or the way they are integrated into the class.

3.6 Analysis of Results

The information gathered will be used to refine the design of the vignettes for the next course. This feedback phase will enable us to identify which models have caused the most confusion, which scenes have worked best, and which visual elements are most or least effective for the students. The methodology thus provides for a cycle of continuous improvement, which is a central feature of the project's innovative nature.

4. Evaluation System

The assessment procedure consists of three stages:

a) During implementation.

Each time a case study is used in the classroom, a practical check will be carried out to ascertain whether students are able to intuitively identify the probabilistic situation depicted and whether the transition to the formal model is made smoothly. This will be assessed through brief, ad hoc checks (short questions, identification of the appropriate model or brief summaries).

b) At the end of the probability module.

Once the probability models for the semester have been covered, a questionnaire will be distributed via Google Forms through the Virtual Campus. This questionnaire will gather

information on clarity, usefulness and format preferences, as well as suggestions for improvement.

c) Final course assessment.

At the end of the academic year, a comparative analysis will be carried out of performance on the final exam questions relating to probabilistic models, comparing the results with those obtained in previous years. This analysis will enable us to assess whether the vignettes have had a real and measurable impact on the understanding and application of the models. Data from the student questionnaire will also be incorporated to obtain a complete picture of the resource's effectiveness.

5. Expected Results

The proposed use of AI-generated vignettes is expected to enhance students' engagement with probability models by reducing the initial abstraction barrier that typically hinders understanding. By introducing each model through a familiar and visually grounded situation, the approach aims to activate intuition before formalisation and thus provide a more accessible entry point into the mathematical content.

In terms of learning outcomes, the main expected effect concerns students' ability to correctly identify probabilistic structures. The visual representation of each situation is intended to support recognition of the underlying random mechanism, which should in turn improve the selection and application of the appropriate model in exercises and problem-solving tasks. Consequently, a reduction in frequent errors, such as confusion between distributions or misinterpretation of problem statements, is anticipated.

At the classroom level, the use of vignettes is also expected to foster a more participatory learning environment. The initial interpretation of the scene creates a natural space for discussion, encouraging students to articulate hypotheses and connect the visual narrative with prior knowledge. This interaction is likely to facilitate a smoother transition towards formal explanation and to reinforce collaborative reasoning.

Beyond the classroom, the availability of the vignettes on the Virtual Campus is expected to support independent study. By functioning as visual reference points, the materials may help students recall the logic associated with each model and organise their understanding more effectively over time. In this sense, the vignettes can act as cognitive anchors that strengthen retention in the medium and long term.

A further expected outcome relates to students' confidence when dealing with probabilistic content. Approaching formal notation through an initial intuitive representation may reduce the perceived difficulty of the subject and contribute to greater self-efficacy, as well as to a more positive attitude towards quantitative methods.

Finally, these combined effects are expected to translate into measurable improvements in academic performance, particularly in assessment tasks related to probability distributions. A comparison with results from previous academic years will provide an empirical basis to evaluate whether the integration of vignettes has contributed to a more consistent and accurate application of probabilistic models.

6. Conclusions

This paper presents the design of a teaching innovation project that addresses a well-documented problem in statistics education: the abstraction barrier that prevents many students in Economics and Business degrees from building a solid intuitive understanding of probability models before encountering their formal treatment. The proposed approach combines generative AI to produce customised visual materials with a structured pedagogical sequence, scene → idea → formalisation, that is applied consistently at the start of each thematic block. The result is a replicable teaching routine grounded in the literature on cognitive load, visual reasoning and statistics education.

The evidence reviewed in Section 2 supports the two-core premises of this project: that activating intuition before formalisation reduces cognitive load and improves comprehension [1], and that comics and visual narratives are an effective vehicle for that activation in subjects where abstraction and student anxiety tend to reinforce each other [2] [3] [4]. What generative AI adds to this picture is not a new pedagogical principle, but a practical solution to a production problem that has historically limited the scalability of visual approaches in university teaching.

The expected outcomes described in Section 5, fewer errors in model identification, greater engagement with formal notation, and improved exam performance, will be evaluated through the comparison of

results across cohorts and through student feedback collected via questionnaire. Whether or not the data confirm these expectations, they will contribute empirical evidence to a field where systematic studies at university level remain scarce, particularly on the specific challenge of teaching discrete and continuous probability distributions to non-specialist audiences.

Beyond the immediate context, the teaching protocol that will be produced at the end of the project is intended to make the methodology transferable to other quantitative courses and institutions, without requiring prior expertise in AI or graphic design. In this sense, the project's contribution is not only the set of materials generated, but the documented process for producing and using them, which other teaching teams can adapt to their own disciplinary context.

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