



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

Ana Suárez-Álvarez<sup>1</sup>, María R. Vicente-Cuervo<sup>1</sup>, Claudia Suárez-Arbesú<sup>1</sup>, Ana Salomé García Muñiz<sup>1</sup>

<sup>1</sup> Department of Applied Economics, University of Oviedo, Spain

## 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].





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 use of AI-generated diagrams is expected to have a positive and significant impact on students' learning experience, particularly in their understanding of probability models, which are often perceived as abstract and difficult to grasp. The use of everyday scenes and situations familiar to students helps to engage their intuition before they encounter formal notation, reducing initial resistance and facilitating a more accessible introduction to the content.

Firstly, a clear improvement in conceptual understanding is anticipated. The vignettes enable students to identify more quickly, and accurately which probability model corresponds to each situation, which aids in selecting the correct model in applied exercises. This impact is expected to be reflected in a reduction in typical errors, such as confusion between distributions or difficulties in interpreting statements, and in an increase in the consistency with which they approach problems associated with each distribution.

Furthermore, a direct impact on classroom participation is anticipated. The initial 'reading' phase of the cartoon encourages students to propose interpretations, relate the scene to real-life situations and articulate hypotheses, creating a space for active engagement before moving on to mathematical formalism. This dynamic not only improves the classroom atmosphere but also increases the group's involvement in knowledge construction and collaborative reasoning.

Thirdly, an improvement in independent learning is expected. The publication of the cartoons on the Virtual Campus will allow students to use them as a visual reference during their study sessions, making it easier to recall the logic behind each model and strengthening retention in the medium and long term. The cartoons can function as "cognitive anchors" that help organise the content and accurately recall which phenomenon each distribution describes.

Another expected outcome is an increase in students' confidence and self-efficacy when dealing with mathematical content. By first grasping the intuitive idea and then the formal formulation, the sense of difficulty is reduced and working with probabilistic models becomes routine, which may have a positive effect on their ability to tackle new problems and on their overall perception of statistics as a useful and accessible tool.

Finally, a measurable impact on academic performance is expected: specifically, that marks in the syllabus section relating to these models will be higher than in previous years, both in exam questions linked to these distributions and in the quality of open-ended answers. Comparison with previous years will allow us to objectively verify whether the use of vignettes has contributed to an improvement in the understanding and application of the 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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### REFERENCES

- [1] C. Batanero and R. Álvarez-Arroyo, "Teaching and learning of probability," *ZDM – Mathematics Education*, vol. 56, no. 1, pp. 5–17, 2024. <https://doi.org/10.1007/s11858-023-01511-5>
- [2] M. van Wyk, "The Use of Cartoons as a Teaching Tool to Enhance Student Learning in Economics Education," *Journal of Social Sciences*, vol. 26, no. 2, pp. 117–130, 2011.
- [3] R. Bestil and R. Punla, "Bringing Math to Life: Enhancing Problem Solving Skills in Probability of Random Variables through Digitized Comics," *Psychology and Education: A Multidisciplinary Journal*, vol. 41, no. 10, pp. 1207–1228, 2025. <https://doi.org/10.70838/PEMJ.411010>
- [4] P. Karimi, R. Gavagsaz-Ghoachani and M. Phattanasak, "Investigating the transfer of scientific content with the help of comic stories at a level of higher education," in *Proc. RI2C 2021*, pp. 205–210. <https://doi.org/10.1109/RI2C51727.2021.9559778>
- [5] T. Groensteen, *Comics and Narration*. Jackson: University Press of Mississippi, 2013.
- [6] L. Gonick and W. Smith, *The Cartoon Guide to Statistics*. New York: William Morrow / HarperCollins, 2015.
- [7] E. Kasneci et al., "ChatGPT for good? On opportunities and challenges of large language models for education," *Learning and Individual Differences*, vol. 103, p. 102274, 2023. <https://doi.org/10.1016/j.lindif.2023.102274>
- [8] UNESCO, *Guidance for Generative AI in Education and Research*. Paris: UNESCO, 2023. <https://doi.org/10.54675/EWZM9535>
- [9] T. Eapen, K. Pedada and A. Sinha, "Bring Course Concepts to Life with Cartoons: A Simple, AI-Assisted Approach to Designing and Using Comics in the Classroom," *Harvard Business Publishing Education*, 2026.
- [10] M. A. Martin, "Truth in edutainment: What you get is what you see," *Teaching Statistics*, vol. 45, no. 3, pp. 143–145, 2023. <https://doi.org/10.1111/test.12353>
- [11] M. Cladera, A. Suárez-Álvarez and M. Vicente, "Changes in Students' Attitudes Towards Econometrics during an Introductory Course: Are There Any Gender Differences?" *Studies of Applied Economics*, vol. 43, no. 2, 2025. <https://doi.org/10.25115/PVKQMG23>