

Generation of Assisted Learning Objects: The UTNG Case

Generación de objetos de aprendizaje asistidos, caso UTNG

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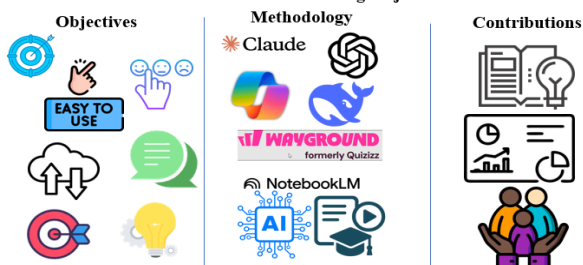
Abstract

This study evaluates the effectiveness of using artificial intelligence-assisted learning objects [LO] in teaching teachers the fundamentals of Python programming. Through action research in education, a set of artificial intelligence tools, such as Claude, NotebookLM, DeepSeek, ChatGPT, Copilot, and Wayground, were developed with the aim of creating useful learning artifacts such as automated quizzes, web pages, and podcasts. These elements were combined into a digital object, a learning and assessment instrument, that was used in a course for UTNG teachers. The research was based on eight parts: usability, ease of use, clarity, alignment with goals, interest, feedback, transfer to classes and total satisfaction by type of LO [web pages, audios, guided exercises, videos, simulators]. The data show that LOs that use AI offer great opportunities to enrich the teaching-learning processes by facilitating dynamic experiences tailored for the student. Their use requires careful review and conscious adjustment by teachers, maintaining a balance between new technologies and humanism in pedagogy.

Resumen

El estudio hace una evaluación de la efectividad de usar objetos de aprendizaje [OA] asistidos con inteligencia artificial en la enseñanza a profesores sobre los fundamentos de programación en Python. Por medio de una investigación-acción en educación, se trabajaron un conjunto de herramientas de inteligencia artificial, como Claude, NotebookLM, DeepSeek, ChatGPT, Copilot y Wayground; con el objetivo de hacer artefactos útiles para aprender como cuestionarios automáticos, páginas web y podcasts. Estos elementos se unieron en un objeto digital instrumento de aprendizaje y evaluación que se usó en un curso para maestros de UTNG. La investigación se basó en ocho partes: usabilidad, sencillez de uso, claridad, alineación con metas, interés, retroalimentación, transferencia a las clases y satisfacción total por tipos de OA [páginas web, audios, ejercicios guiados, videos, simuladores]. Los datos muestran que los OA que usan IA ofrecen grandes oportunidades para hacer más ricos los procesos de enseñar-aprender facilitando experiencias dinámicas y hechas para el alumno. Su uso exige revisión cuidadosa y ajuste conciente por parte de los profesores, manteniendo balance entre nuevas tecnologías y humanismo en pedagogía.

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Artificial intelligence education, learning objects, teacher training

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Inteligencia artificial en educación, objetos de aprendizaje, capacitación docente

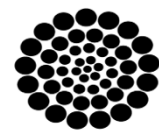
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Introduction

AI-enhanced learning objects [LOs] integrate structured educational content with adaptive properties, which individualize learning experiences and support automated intelligent feedback. The value of these works lies in their empiricism about the effectiveness of new technologies for teaching—in this case, new technologies related to Python programming, which can transform the school environment by automatically analysing code and generating exercises that adapt based on student outcomes.

This research examines eight specific aspects [perceived usefulness, ease of use, clarity, alignment with learning objectives, engagement, feedback, transfer to the classroom, and overall satisfaction] differently across LO types [web pages, audio, guided exercises, videos, simulators]. It is characterized by the fact that teachers are also students and can learn from two different perspectives: the efficiency of the learning process and the application to pedagogy.

It applies a non-experimental quantitative methodology using multilevel statistical analysis and includes iterative improvement frameworks focused on specific findings.

Central Problem and Hypothesis

The main challenge is the discrepancy between the theoretical promise of AI-supported learning outcomes and what has been demonstrated regarding their actual impact on the quality of programming instruction.

The main hypothesis is that learning outcomes will present different levels of satisfaction depending on the type and dimension of learning outcomes evaluated, with simulators and guided exercises being the modes that obtain the highest ratings of usefulness and transfer to the classroom from users.

The article comprises the following sections:

Theoretical Framework: conceptual basis of learning outcomes and educational AI.

Methodology: non-experimental quantitative design, teachers as participants, evaluation instrument.

Results: descriptive and inferential analysis by dimension and type of learning outcome.

Discussion and Conclusions: interpretation of results and suggestions for practical and institutional implementation.

Theoretical Framework

This theoretical framework examines how IA technologies enhance autonomous and creative learning, aligning with the needs of digital-native students in today's educational landscape

Wayground

Wayground was originally known as Quizizz, providing an online quiz tool that now includes expanded capabilities for active learning with AI. According to [Gupta, 2025], founder and CEO, the new brand reflects the platform's growth from a simple formative assessment tool to a space for teachers to find, import, or create all the educational content they need and deliver it to students anywhere, anytime.

Enabling this is the introduction of generative AI, and the corresponding product that makes it one-click to generate interactive quizzes, passages, questions, and multi-part assignments from a web page [Kelly R., 2025]. This is the kind of power that is formative for everyone and removes the technical constraints that have limited teachers in the past.

Today, Wayground is used in over 150 countries and by 2025 will serve 90% of schools in the United States, leading the interactive digital assessment industry.

Microsoft Copilot

Microsoft Copilot is an AI-based assistant integrated into Windows and Microsoft 365. It's a tool that helps students develop critical thinking, creativity, problem-solving, and digital collaboration skills. All of this is achieved through intelligent content generation [writing, scripting, and document creation]; voice can be used instead of a keyboard, allowing students to understand instructions in natural language. It performs semantic file searches in Windows, not only finding exact word matches but also understanding the meaning of what you type.

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It can also filter information from images and scanned documents based on file type, date, or content.

It is developed as a programming assistant for GitHub Copilot; its main features include auto-completion and code and command suggestions, a chat that allows interaction with programming questions, and a summary of changes, facilitating reviews.

At the [Norwegian University of Science and Technology, 2024], a study was conducted to evaluate the impact of Microsoft Copilot Chat on computer science teaching, which resulted in improved understanding of technical concepts, increased student participation, development of problem-solving skills, and positive feedback for teachers.

Claude

Claude is developed by Anthropic, a company founded by former Open AI researchers. The first version was released in 2023, and later evolved into Claude 2 and Claude 3.5 Sonnet.

What sets it apart from other AIs is its safety philosophy, which avoids generating harmful information, ensuring responsible responses, avoiding discriminatory behaviour, and aligning them with human values, including respecting social norms and cultures and adapting to human contexts.

It supports students in understanding and reasoning for themselves, rather than just copying answers. This is achieved with the help of the Learning tools [it functions as a tutor that generates questions, proposes exercises, and helps solve problems] and Explanatory [it provides detailed, step-by-step explanations of a topic with examples].

Its AI can be integrated with other platforms [Moodle, Canvas, Google Classroom, Blackboard], allowing for the generation of study guides, summaries, access to course materials, and personalization of the learning experience.

NotebookLM

It's AI research and writing assistant. It was launched in 2023 as Project Tailwind, and in August 2025, Google integrated it as Google Workspace for Education.

Currently, two versions are available: the free version and the NotebookLM Plus version. It allows users to upload PDF documents, Google Docs, presentations, and web links to generate high-quality audio summaries, videos, mind maps, and reports. It also provides automated feedback on assignments and projects, based on the characteristics specified by the user.

Unlike other AI assistants, it works only with information provided by the user, eliminating the risk of hallucinations and transforming chaotic information into structured and useful results.

Chat GPT

GPT stands for Generative Pre-trained Transformer, an artificial intelligence model designed to learn language patterns by reading large volumes of text and subsequently generating coherent responses. The first version was released in 2018 by Open AI, followed by significant improvements with GPT-2 [2019], GPT-3 [2020], and GPT-4 [2023].

Currently, GPT-3.5 is offered in different plans: GPT-4 Plus, with free and limited access; GPT-4 Plus, through a monthly subscription; and GPT-4 Enterprise, with a variable cost based on usage and required scale. The latter provide faster, more accurate, and more adaptable responses to each user's needs.

One of its unique features is its ability to interact in a natural and understandable way, thanks to training that combines human correction of responses with reinforcement learning, which has improved its coherence and behaviour. In this way, GPT has become an accessible and useful tool for educational, creative, and professional tasks.

DeepSeek

It was launched in 2023 by a Chinese company specializing in artificial intelligence research. It is characterized by its Open-Weight approach, a philosophy that promotes openness and empowerment for developers and companies, allowing the model to be customized to their needs without relying on external APIs. It also facilitates the processing of sensitive information on local servers, thus avoiding data transfer to third parties.

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This initiative encourages global collaboration among developers, who can contribute to its improvement, create model variants, and find innovative applications.

It is completely free, with no strict restrictions or the need for paid subscriptions. It offers an extensive context of 128k tokens, enabling the analysis of long documents, code debugging and analysis, as well as coherent and extended conversations without losing previous information. It is also capable of comparing ideas and synthesizing information from multiple sources.

Thanks to its development in a Chinese cultural and linguistic environment, DeepSeek has a superior understanding of Chinese character structure, including idioms, cultural references, and specific social contexts.

Student Learning

Teaching is, above all, a profession governed by rules, whose fundamental intention is to generate learning processes, where educational practice is put into motion. It is a set of intentional actions of an "I" to generate learning in a "you," carried out in the classroom or any other place, but which truly educate.

Considering that students currently enrolled at the university level are digital natives, they have grown up immersed in technology, so their way of communicating and interacting is different, ignoring this creates an unmotivating context, leading us to the behaviourist pedagogical model, which aims to systematize, measure, manipulate, evaluate, classify, and project how students will behave after instruction.

Box 1

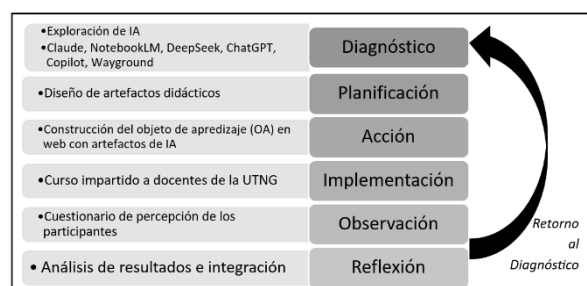


Figure 1

Research - action methodology

Adapted from [Kemmis & McTaggart, 1998]

Currently, modern pedagogy emphasizes that students must develop their own personality and cognitive abilities. Thus, there is an intersubjectivity, where it is constituted by the teacher and the student. Both are different, but actions are taken to understand the same thing or something close to it.

Online materials facilitate active and autonomous learning, allowing people to learn by doing while sharing a common language.

Cesar Coll describes, "The challenge is not to use technology to do the same thing we did without it, but to do things differently, to create new learning opportunities, and to expand the spatial and temporal boundaries of educational activity."

Methodology

This research was developed under the educational action research approach, as it allows teachers and researchers to reflect and transform their practice through a cycle of diagnosis, planning, action, observation, and reflection [Elliott, 1993].

In the first stage, various artificial intelligence tools such as Claude, NotebookLM, DeepSeek, ChatGPT, Copilot, and Wayground were explored and applied to design and produce AI-assisted teaching artifacts. These teaching artifacts ranged from automated questionnaires to web pages and podcasts. Subsequently, some of these artifacts were gradually integrated into a web page designed to build a constantly evolving digital learning object.

In a second stage, this object was implemented within a course taught to teachers at the UTNG, thus allowing its applicability to be assessed in a real-life training context. Finally, a questionnaire was administered to evaluate participants' perceptions of the pedagogical usefulness of the artifacts and the impact of the use of AI in the design of educational materials.

This methodology is relevant since it articulates the production of knowledge with the continuous improvement of teaching practice, see figure 1, and integrates both technological innovation and critical reflection on its use in educational contexts [Carr & Kemmis, 2003].

Results

The results obtained include: the website, which is programmed in HTML, CSS, and JavaScript with development assisted by the AI Claude, but adapted and installed on a freely accessible server. For this, it is essential that the teacher has experience in the aforementioned languages.

The result can be seen in Figure 2 and is available online at the following URL: <https://tuxmex.github.io/curso-python-tutorial/>

Box 2



Figure 2

Screenshot of the Python course website

Created figure

Likewise, various teaching artifacts were developed, seeking to provide different alternatives to explain the topics that make up the course, including guided exercises and explanations through digital content in audio form, better known as podcasts [see figure 3].

Box 3

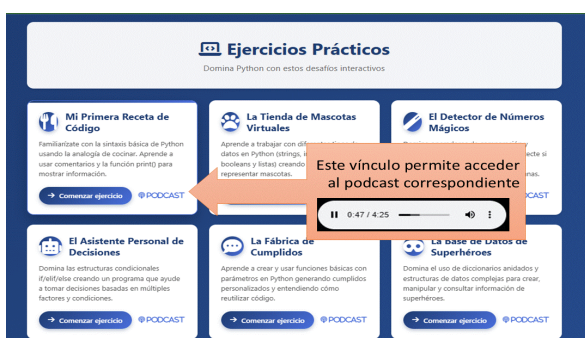


Figure 3

Practical exercises screen

Created figure

All of these artifacts are developed with the help of an AI. However, the teacher aims for them to be logically coherent and appropriate for each topic. Each artifact was created based on a specific need, which was provided to the AI to process.

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It's important to note that each of these tools allows for fast, high-quality work, but they are constantly monitored and adapted by the teacher. Each one is a great experience, making it very clear what AI is capable of, from a simple text summary to an almost human-like explanation via audio, even with the teacher's own voice.

The development of the teaching artifacts presented was not only an additional teaching material, but also an opportunity to immerse oneself in the world of AI, geared toward one of the most important tasks of our existence: learning.

Once the learning objects were developed, they were tested with 13 teachers, who were given a 10-question questionnaire in order to collect their impressions and suggestions in order to ultimately seek to improve said objects. A brief summary of the results obtained is shown below: The majority, that is, 76.9% of those surveyed, consider that the course materials helped them better understand the concepts; 84.6% considered them easy to use in terms of navigation, access, and clear instructions; regarding the level of explanation and sequencing, it is adequate for their profile, 69.2% considered it adequate; 76.9% considered the material aligned with the course objectives and maintained their interest and motivation, receiving useful and timely feedback. 84.6% were satisfied with the materials used [see Figure 4]. These results indicate that the vast majority of students found the learning objects useful. Considering the level of teacher demand, it can be said that while improvements are needed and even efforts to adapt the materials to different profiles, the acceptance and utilization rate are very positive and validate the usefulness of AI assistance. The satisfaction level is shown in Figure 4.

Box 4

Estoy satisfecho/a con los materiales de aprendizaje utilizados en el curso.

13 respuestas

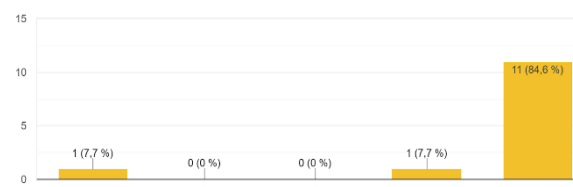


Figure 4

Satisfaction Level

Figure result from Google Forms

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No less important were the contributions made by participants, which should be taken into account for future editions of the course. Some of their contributions were: "Great course! I think if I could ask for anything, it would be much more time, please!"; "Continue in-person training!"; In these contributions, and in the majority of those received, a great acceptance of the learning objects can be detected. But something very important is that they recognize the opportunity to have a teacher at the helm. It is emphasized that AI assistance is very important, but the teacher is a key player in the teaching-learning process. The questionnaire used for data collection is attached as a supplement at the end of this document.

Conclusions

The research concludes that AI-assisted learning objects represent a valuable opportunity to enrich teaching and learning processes. These teaching materials allow teachers to dedicate more time to pedagogical planning and reflection, while students enjoy more dynamic and personalized educational experiences. Artificial intelligence offers the possibility of accelerating the generation of ideas and resources in a matter of minutes, although its use requires critical and conscious review by teachers, who must evaluate, adapt, or even rework artifacts when necessary.

The use of artificial intelligence in education, therefore, must be undertaken gradually and strategically, taking advantage of its benefits without becoming overly dependent. The role of the teacher remains central: they must guide the educational process, guarantee quality experiences, and maintain a balance between technological innovation and pedagogical humanism.

Artificial intelligence is a powerful tool for better engaging with students, but it does not, on its own, constitute the entirety of teaching strategies. Teachers must also complement those limitations that AI cannot overcome, such as fostering critical thinking, social interaction, and creating a space for debate and reflection.

Consequently, the contemporary challenge is learning to coexist with AI as an educational resource, taking advantage of the best that technology offers while always prioritizing the human and educational aspects.

Teaching requires constant updating; however, in the current context, this need takes on an immediate character. Teachers must adapt to new generations, who operate in digital environments characterized by the immediacy of information and the abundance of technological resources. In this scenario, it is essential that teachers design and offer learning objects that are not only engaging but also promote meaningful and sustainable educational experiences.

However, instant access to information must be accompanied by processes of reflection, critical awareness, and in-depth analysis so that students can develop intellectual independence and autonomy in their learning. To achieve this, the role of teachers is essential, as they must balance the use of emerging technologies with the development of cognitive and socio-emotional skills that allow students to transcend the immediacy of data and construct knowledge in a critical and responsible manner.

Annexes

Data Collection Instrument:

In an effort to improve the teaching resources used in the course you have just taken, we kindly ask you to answer the following questions. The information provided is anonymous and confidential.

Thank you very much for your time and cooperation!

Instructions: Select the option that best represents your opinion. Likert scale from 1 [Strongly disagree] to 5 [Strongly agree], except where another type of response is indicated.

Tables and adequate sources.

1. The course learning materials helped me understand Python concepts.
2. The materials were easy to use [navigation, access, clear instructions].
3. The level of explanation and sequencing of the materials were appropriate for my profile.
4. The materials were aligned with the course objectives.
5. I received useful and timely feedback through the materials [solutions, hints, self-assessments].

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6. I believe I can apply what I have learned in activities or exercises beyond the content of the material.
7. I am satisfied with the learning materials used in the course.
8. Which of the following material formats was most useful for your Python learning?
 - a. Web pages/guided readings
 - b. Audio elements/podcasts
 - c. Guided exercises/step-by-step practices
 - d. Videos/micro-lessons
 - e. Other
9. Which of the following material formats did you use most frequently?
 - a. Web pages/guided readings
 - b. Audio elements/podcasts
 - c. Guided exercises/step-by-step practice
 - d. Videos/micro-lessons
 - e. Other
10. What recommendations or suggestions can you offer to improve the learning materials used in the course?

Declarations**Conflict of interest**

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Author contribution

Rodríguez-García, Anastacio: His contribution lies in the conception of the project. He initiated the exploration and study of AI tools for the generation of learning objects. He provided the technical knowledge for the generation of educational artifacts, implementing the theory and practice of the LO and its methodology.

Barrientos-Avalos, Eduardo: His work involved practical design of the methodology. He created the assessment instrument in the predetermined dimensions, as well as the statistical analysis of participant data and the generation of research results.

Mendez-Mendoza, Maricela: She is dedicated to the analysis of the theoretical framework through a bibliographic review and pedagogical validation of the contents, and the writing/revision of the document with educational experience.

Availability of data and materials

The data supporting the conclusions of this article are available from the corresponding author upon reasonable request. The digital learning object developed in this study is publicly accessible at <https://tuxmex.github.io/curso-python-tutorial/> and <https://github.com/tuxmex/curso-python-tutorial>.

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Abbreviations

AI	Artificial Intelligence
CSS	Cascading Style Sheets
GPT	Generative Pre-trained Transformer
HTML	HyperText Markup Language
IA	Inteligencia Artificial
LO	Learning Object
OA	Objeto de Aprendizaje
UTNG	Universidad Tecnológica del Norte de Guanajuato

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