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# Impact of Generative Artificial Intelligence on the efficiency, quality, and innovation in the production of Open Educational Resources for MOOCs

*Impacto de la Inteligencia Artificial Generativa en la eficiencia, calidad e innovación en la producción de Recursos Educativos Abiertos para MOOCs*

*Impacto da Inteligência Artificial Generativa na eficiência, qualidade e inovação na produção de Recursos Educacionais Abertos para MOOCs*

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The research analyzes the impact of Generative Artificial Intelligence (GAI) in the creation of audiovisual and multimedia content through a comparative study of Open Educational Resources (OER) developed in two MOOCS (n = 121) focused on combating misinformation, one using GAI and the other not. The analysis compares both the production processes, and the results obtained in important dimensions such as efficiency, technical and formal quality and accessibility of the tools. The results show that GAI improves the efficiency and quality of OER production and enables the creation of high-quality content at a lower cost. Their use enables more accessible and scalable productions and expands the possibilities for creating advanced digital educational content.
KEYWORDS: Generative artificial intelligence, multimedia education, digital communication, educational resources.

*Esta investigación analiza el impacto de la Inteligencia Artificial Generativa (IAG) en la creación de contenidos audiovisuales y multimedia mediante un estudio comparativo de Recursos Educativos Abiertos (REA) desarrollados (n = 121) en dos MOOC enfocados en combatir la desinformación, donde uno emplea IAG y el otro no. El análisis compara tanto los procesos de producción como los resultados obtenidos en dimensiones clave como eficiencia, calidad técnica y formal y accesibilidad a las herramientas. Los resultados muestran que la IAG mejora la eficiencia y calidad en la producción de los REA, facilitando la creación de contenidos de alta calidad con un menor coste. Su uso permite producciones más accesibles y escalables ampliando las posibilidades de creación de contenido educativo digital avanzado.*
*PALABRAS CLAVE: Inteligencia artificial generativa, educación multimedia, comunicación digital, recursos educativos.*

*Esta pesquisa analisa o impacto da Inteligência Artificial Generativa (IAG) na criação de conteúdo audiovisual e multimídia por meio de um estudo comparativo de Recursos Educacionais Abertos (REA) desenvolvidos (n = 121) em dois MOOCS voltados para o combate à desinformação, sendo que um utiliza IAG e o outro não. A análise compara os processos de produção e os resultados obtidos em dimensões importantes, como eficiência, qualidade técnica e formal e acessibilidade às ferramentas. Os resultados mostram que a AGI melhora a eficiência e a qualidade da produção de REA, facilitando a criação de conteúdo de alta qualidade a um custo menor. Seu uso permite produções mais acessíveis e dimensionáveis, expandindo as possibilidades de criação de conteúdo educacional digital avançado.*
*PALAVRAS-CHAVE: Inteligência artificial generativa, educação multimídia, comunicação digital, recursos educacionais.*

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## Introduction

The launch in November 2022 of ChatGPT put artificial intelligence (AI) at the center of the social debate. Although the concept of AI was first defined in the 1950s (Abeliuk & Gutiérrez, 2021), and research into it had been ongoing for decades (Haenlein & Kaplan, 2019), the successive announcements by OpenAI (2024) demonstrated the disruptive and all-encompassing nature that these technologies had already attained.

Some of the techniques that support the creation of audiovisual products through Generative Artificial Intelligence (GAI), such as GAN (Generative Adversarial Networks), were introduced a few years earlier, in 2014 (Wang & Ye, 2022), but it was not until late 2022 (Vega Jiménez et al., 2023) that an endless succession of AI tools that could generate audiovisual content in different formats began to emerge (Sánchez-García et al., 2023).

GAI has shown great ability to carry out intellectual tasks that until now required advanced cognitive skills (Takeyas, 2007), and to do so in a way that is virtually indistinguishable from the result of human creation. This has revolutionized every professional sphere (Mathur et al., 2020). In fact, some of the leading international corporations, such as Amazon (Zwakman et al., 2021) and Microsoft (Dash, 2023), quickly introduced these AI tools to improve their work processes (Pérez González et al., 2023).

Naturally, the communications and journalism sectors have also felt the impact of GAI (Túñez-Lopez et al., 2021). Under the precepts of the theory of disruptive innovation (Christensen, 1997), we are witnessing profound changes that are significantly affecting every work and creative process: from task automation (Corvalán, 2019) to the assisted acceleration of creative audiovisual production processes (Sarzi-Ribeiro & Sedeño-Valdeldós, 2024).

Against this backdrop, it is necessary to understand the possibilities that GAI offers in creative audiovisual production processes. Specifically, this work focuses on exploring how GAI can improve the design and production of Open Educational Resources (OER) in the creation of massive open online courses (MOOC).

## Approaches to the present and future of the audiovisual sector in the era of GAI

The incremental use of GAI tools has driven an intense professional debate (González Arencibia & Martínez Cardero, 2020) with two opposing views that support their arguments based on the opportunities and threats they present, and which in some way reshape and modernize the eternal debate between proponents and detractors (Eco, 1965).

First, there are those who view GAI as an effective tool for maximizing creative processes (Calvo et al., 2023) and believe it fosters the development of audiovisual and multimedia productions. In contrast, there are those who note its risks and threats, such as replacing human labor in complex thought tasks with machines (Álvarez, 2023), which will result in the disappearance of jobs in the audiovisual and journalistic fields (Gutiérrez-Caneda et al., 2023), while yet others underscore the false perception of reality that AI can create by making what is real indistinguishable from what is generated by these technologies (Fernández Mateo, 2023).

Beyond the initial apprehension toward AI, there is no denying that its integration in creative processes is growing exponentially, making it essential to prepare adequately to understand its scope, risks, and limitations, as well as to harness its potential.

The European Parliament has acknowledged the impact AI has on the audiovisual sector in tasks such as automated indexing, detecting illegal content, and content personalization in multilingual contexts (Rehm, 2020). However, the use of AI needs the establishment of appropriate laws and regulations to address challenges related to its ethical uses (Sarzi-Ribeiro & Sedeño-Valdellós, 2024; Suárez-Muñoz, 2024), threats to privacy (Kaufman et al., 2023), the generation of biases (Campi, 2023), or discrimination in certain cultural or social contexts.

Creative spaces will be conditioned by the frames of action and training initiatives implemented to ensure its proper and ethical use (De Lara et al., 2022; García-Peñalvo, 2023; Terrones Rodríguez, 2018), hence the importance of understanding the scope and opportunities of these technologies. In the design of these global ethical frameworks, the European Commission has been working since 2021 to ensure the safety and reliability of AI (European Commission, 2024).

In December 2023, the European Council and Parliament reached a political agreement on the use of AI tools and their associated risks (European Commission, 2023), which resulted in the Artificial Intelligence Regulation (European Parliament, 2024), the first international law to establish standardized rules on the use and development of AI.

Meanwhile, in 2021, the 193 member States of Unesco adopted the first universal regulatory framework on AI ethics, addressing the responsible use of AI tools for "the good of humanity, individuals, societies and the environment and ecosystems" (United Nations Educational, Scientific and Cultural Organization [Unesco], 2023).

In professional contexts, manuals have been developed to provide guidance on the use, scope and limitations of AI in various fields, which can serve as references for the communications sector in areas like healthcare (Moreno & Sanz, 2023) and administration (Estevez et al., 2020). Companies have started training their employees on the application and integration of AI into professional processes (Prodigioso Volcán, 2023), and into the field of higher learning. For example, the Conferencia de Rectores de las Universidades Españolas (CRUE) and numerous universities have developed recommendation guides for applying AI in education (EUA, 2023). This is a matter of great significance, and its importance was already noted by Unesco when it addressed the need to integrate this training within a context of a plurality of literacy (Shnurenko et al., 2021), and which also requires reformulating how new generations of communicators are trained.

## GAI IN THE PROCESSES OF CREATING AUDIOVISUAL AND MULTIMEDIA CONTENT

One of the great opportunities offered by GAI is the democratization, through low-cost applications, of the audiovisual and multimedia creation process. Its impact on elaborative processes, particularly through the acceleration and simplification of creation and post-production tasks, is already undeniable (Franganillo, 2023). The ability to generate visual and artistic content (Serrano et al., 2023) in the different areas and applications of the creative industries (Alonso, 2023) is a daily

reality that affects every one of its phases, from the conceptualization to the dissemination of audiovisual and multimedia content. Nothing can escape this change any longer, meaning the inclusion of these tools in creative processes for scriptwriting, production, and the development of audiovisual and multimedia educational products is now both a necessity and an opportunity.

Due to its multipurpose characteristics, AI can be useful and applicable at any stage of the audiovisual and multimedia content creation process (Guerrero-Solé & Ballester, 2023), considering, from a traditional perspective, all the basic phases of production (Ohanian & Phillips, 2013), from pre-production to post-production (Soto Alvarado, 2015).

AI tools offer a multitude of possibilities within the realm of audiovisual and multimedia creativity and production. Various studies underscore the potential of AI to advance production processes in different areas, such as in the production of digital art (Rani et al., 2023), music (Briot et al., 2020) and television (Wright et al., 2023). Anantrasirichai and Bull (2022) categorize how AI is utilized in the creative industries, identifying the following functions: content creation, information analysis, content and workflow enhancement, improved information and data insights.

In the field of communication, GAI allows content to be created based on patterns previously learned through deep learning models trained with massive datasets, the majority of which come from collections of resources available online (García-Peñalvo & Vázquez-Ingelmo, 2023; Prodigioso Volcán, 2023).

As these technologies have evolved thanks to refined Generative Adversarial Networks (GANs) and Convolutional Neural Networks (CNNs), the market for GAI applications has grown exponentially in the past year. Applications like ChatGPT, Sora, DALL-E 2, Stable Diffusion, Adobe Firefly, Synthesia, and Midjourney are now part of the toolkit of audiovisual and multimedia professionals. These tools can generate various models in different accessible formats (García-Peñalvo et al., 2024).

Given this context, we are now on the verge of the launch of Sora (Brooks et al., 2024), which promises a new disruption through

creative artificial intelligence (Hubert et al., 2024) or artificial general intelligence (AGI) (Buttazzo, 2023) models.

## AI IN THE PRODUCTION OF EDUCATIONAL AUDIOVISUAL AND MULTIMEDIA CONTENT

In a very short period of time, AI has become an accessible tool capable of enhancing and optimizing audiovisual and multimedia production processes in any domain and application. As noted by various forums and international associations specializing in the development of audiovisual content for education, such as the Media & Learning Association (MLA), and reflected in international reports by educational entities like the U.S. Department of Education (2022) and the European Parliament (2021), AI holds tremendous potential to enrich the creation of educational audiovisual and multimedia content in a way that enables new learning opportunities that are more adaptive, enriched, and interactive (Aparicio Gómez, 2023).

Within the broad spectrum of audiovisual and multimedia products for education, recent research (Morales-Chan et al., 2023) has shown how the audiovisual production of educational resources for Massive Open Online Courses (MOOC) benefits from the use of AI tools to assist in the processes to design, develop and produce effective learning activities. Versatility in the production of educational videos (Pellas, 2023) is one of the trends highlighted in 2024 by the eLearning Innovation Center at Universitat Oberta de Catalunya (Gómez-Cardosa & García-Brustenga, 2023), alongside avatar-assisted multilingual production, personalization and adaptability of content based on the student profile, and the creation of semi-automated multimodal content.

But the greatest impact of GAI in the production of audiovisual and multimedia educational content arguably lies in the significantly expanded production capacity, both in quality and quantity, democratizing the development of highly sophisticated products that previously required much more complex production environments.

This requires research that reflects on the impact and application of AI in the development of MOOCs so as to understand its advantages and propose strategies to improve production processes (Acaro Rogel et al., 2024; Torres Díaz et al., 2014).

Because of this, the objective of this research is to analyze how Generative Artificial Intelligence can enhance the design and production of Open Educational Resources in the creation process of Massive Open Online Courses.

## Research questions and hypotheses

The following research questions are proposed:

- R.Q.1. What elements of the production of educational audiovisual and multimedia content for MOOCs are modified by the incorporation of GAI?
- R.Q.2. What specific benefits does GAI bring to the creative processes and to the efficient production of audiovisual and multimedia content for MOOCs?
- R.Q.3. In what types of audiovisual and multimedia products can GAI be most effectively employed, and what is the impact of its use on production processes?
- R.Q.4. What are the most commonly used AI tools in the production of video, audio, and/or images for MOOCs, and how are they integrated into the production workflow?

The hypotheses of the study are:

- H.1. The integration of GAI tools and resources into audiovisual production increases efficiency, improves the technical and formal quality of audiovisual and multimedia products in aspects such as image definition, voiceovers, visual diversity, and the incorporation of semi-automated avatars, and it promotes innovation in the process of creating OERs.
- H.2. The technical capabilities and availability of GAI-based audiovisual and multimedia production tools have improved in recent years, making them more accessible and applicable in low-cost creative processes, and facilitating their adoption in the creation of MOOCs.

Table 1 provides the operational definitions of the dimensions analyzed in each hypothesis:

TABLE 1
OPERATIONAL DEFINITIONS, ANALYSIS DIMENSIONS

| HP | Dimension | Definition |
|---|---|---|
| H.1 | Efficiency | The ability to produce more contents or reduce the production time and resources, by comparing the number of products generated, total production time, and resources used between MOOCs with and without GAI. |
| | Technical and formal quality | The level of visual and audio quality of the products as determined by the resolution and definition of the images, the diversity of visual resources, the quality of AI-generated audio, the integration of semi-automated avatars, and other factors. |
| | Innovation | The introduction of new creative elements facilitated by GAI, such as avatars, automatically generated images and synthetic voices, which enhance the variety and complexity of the products created. |
| H.2 | Technical capacity | The advanced capacities offered by GAI tools, such as the automatic generation of audiovisual content and the automation of production processes. |
| | Availability and accessibility | Ease of access and use of GAI tools, assessed in terms of cost, training time, and staff adoption in its creative processes. |

Source: The authors.

## METHODOLOGICAL APPROACH

The research focuses on evaluating OERs produced during the development of two MOOCs. These MOOCs are the result of two research projects funded by the European Union through the Erasmus+ program between 2020 and 2023, aimed at improving media and information literacy to combat misinformation. They serve as case studies to investigate the impact of GAI on the process of producing OERs.

The first project, CRESCEnt (Countering Threats Through Responsible Communication), was carried out in 2020, while the second one, DOMINOES (Digital cOMpetences INformatiON EcoSystem), was conducted in 2023. No GAI tools were used in the first, while in the second, various tools, applications and techniques were employed that rely on these technologies to varying degrees.

The research involves a comparative study of the production processes for both MOOCs, detailing, through a descriptive process, the characterization of workflows, content distribution, and production strategies. Subsequently, the audiovisual products undertaken in both MOOCs are described and analyzed (n = 121). These products include interactive presentations, infographics, videos, images, timelines and activities. All of these products were created using a standardized production methodology based on OERs, as per Gértrudix et al. (2007). This enables OERs to be integrated and reused as standalone entities on any platform or system, whether in educational or communication contexts.

## Characterization of the sample

One of the core priorities of the European Commission 2019-2024 is to promote initiatives that help combat misinformation, and thus ensure the protection of democracy and European values (European Commission, 2023). In this context, the Commission has identified the importance of implementing long-term and permanent educational programs designed to develop critical thinking and enhance resilience against misinformation (European Commission, 2018).

In line with these directives, two European projects, CRESCEnt and DOMINOES, were selected. These projects, funded through the Erasmus+ program, are consistent with the European Commission's priorities and strategies. Researchers led the coordination, production, and audiovisual integration of two MOOCs focused on addressing these themes. These projects aim to design, produce and implement open access MOOCs that seek to raise awareness of disinformation, fake news, counter-narratives, and issues linked to security and defense, strategic communication and journalism.

The comparative analysis spans all the materials developed for the MOOCs of both projects, available for consultation as OERs on platforms such as Zenodo and EPALE (Arcos et al., 2023; CRESCEnt, 2021). In total, 121 products created in both courses were selected, of which 60 belong to the CRESCEnt project and 61 to DOMINOES.

## Information collection and analysis process

Both MOOCs were prepared in keeping with the production model proposed by Gértrudix et al. (2017), which organizes the process into various stages to ensure effective production in low-cost environments. Throughout the scriptwriting, production and development phases, control sheets are implemented to constantly monitor the progress of the production. This monitoring is used to gather detailed information, which is essential for making production decisions.

In order to compare the production processes applied and the results of both MOOCs, a specific analysis sheet was created that is filled out using an online form and that analyzes the audiovisual product of the MOOC on an individual level, depending on the type of product, type of production, the audiovisual production tool, the associated sub-products, the integration of AI, the element in which AI is utilized and the AI production tool. The complete operation of the variables, their indicators and definition are available in Carbonell-Alcocer et al. (2024). To minimize bias when evaluating the materials, a researcher triangulation strategy was adopted, as per Denzin (2017). This means that the analysis sheet was completed by several researchers in order to compare the results of the product evaluation process.

Once the data are recorded, they are organized into frequency tables so as to conduct a descriptive analysis using frequencies and percentages. The details of the analytical procedure and the results obtained are available in Carbonell-Alcocer et al. (2024).

## RESULTS

### *Characterization of the processes to produce and organize the content of the MOOCs*

Both MOOCs are configured as per the standard defined in the URJCx (2024) platform of Rey Juan Carlos University, which promotes open knowledge and adheres to the organizational and production model proposed by Gértrudix et al. (2017). In keeping with this structure, the courses offer learning itineraries organized in five topics. Each topic provides a learning guide divided into three subsections, which in turn contain four training screens each, and ends with an evaluation section. The following work phases have been defined for the production process of both MOOCs:

FIGURE 1
PHASES OF THE PRODUCTION PROCESS OF THE MOOCS


Source: The authors.

A supervised and assisted process is employed to create the script. Based on predefined templates, and in consultation with the coordination and technical teams, specialists in the subject drafted the content script, detailing the information and/or activity to be shown on each of the training screens that comprise each subsection.

Thus, 37 scripts were prepared, 18 in CRESCEnt and 19 in DOMINOES. Based on the analysis of the content scripts, the technical scripts were drafted, taking into account the economic and time constraints for production. In this context, and within the range of possibilities of the basic products that can be developed, the coordination and technical teams turned the textual content into viable proposals for audiovisual and/or

multimedia products. This process involved deciding which audiovisual and/or multimedia formats were best suited to each training screen, taking into account a pre-established production methodology that falls within the project budget.

The aim in this stage was to find the most effective technical solution to meet the communication and educational objectives on each screen. Thus, the narrative logic for each screen was defined, depending on which of the most appropriate elements were selected to be shown, which could be infographics, videos, video classes, interactive videos and/or audiovisual presentations. In this stage, the most suitable format was determined for each material and the most effective tools were chosen to create it, under the supervision of the audiovisual and multimedia production team. To this end, two guides were written, one for each project, specifying the properties and characteristics of each, available in Carbonell-Alcocer et al. (2024).

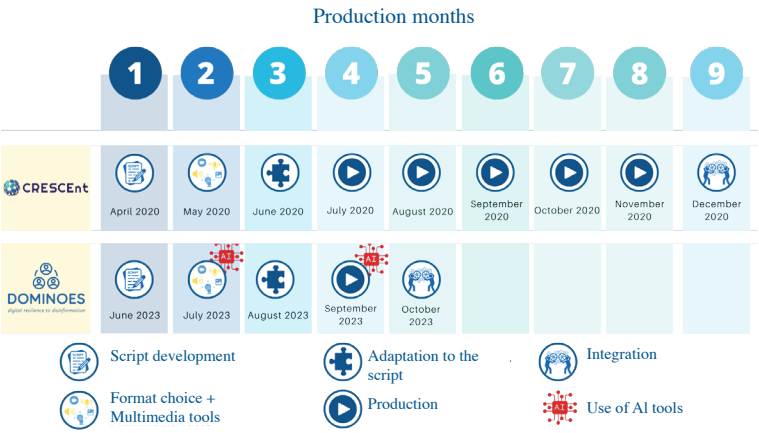
Specifically, the process of adapting the content script to the audiovisual and/or multimedia format selected involved two stages. In the first, content specialists adjusted the scripts to the chosen format following the guidelines of the audiovisual and multimedia production team. In the second phase, the communication experts verified that each script was consistent with the specifications of the chosen format, meaning the audiovisual production phase could commence.

Once production started, the various audiovisual and multimedia products were created, taking into account their specific characteristics. Once completed, content experts evaluated each finished product to confirm it adhered to the initial script and achieved the desired training objectives.

After completing the production of the audiovisual and multimedia resources, they were integrated into the MOOC in the subsections corresponding to each of the products. Finally, to maximize the visibility and usefulness of the resources created, independent products were developed in the OER format and included in repositories such as Zenodo, EPALE, and the Digital Skills & Jobs Platform. As a result of this process, a production model was developed that enabled the serialized and organized creation of two MOOCS in both projects. Figure 2 shows a comparison of the production processes of both projects. It

is notable how, thanks to the incorporation of artificial intelligence in the various stages of the production model, the tasks associated with DOMINOES were not only simplified compared to the CRESCEnt tasks, but they made it possible to undertake more complex audiovisual and multimedia solutions, yielding improved results.

FIGURE 2
COMPARISON OF THE PRODUCTION OF THE TWO PROJECTS




Source: The authors.

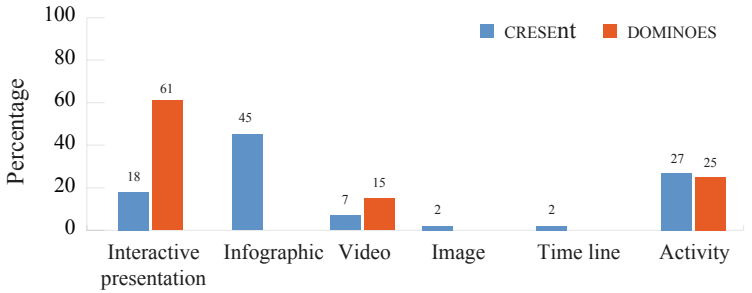
## CHARACTERIZATION OF OPEN EDUCATIONAL RESOURCES (OER)

The MOOCs include a variety of content, such as interactive presentations, infographics, videos, images, timelines and activities. Figure 3 illustrates how these contents are distributed in the two MOOCs.

For the CRESCEnt MOOC, a total of 60 products were developed, including 11 interactive presentations, 27 infographics, four videos, one image, one timeline and 16 activities.

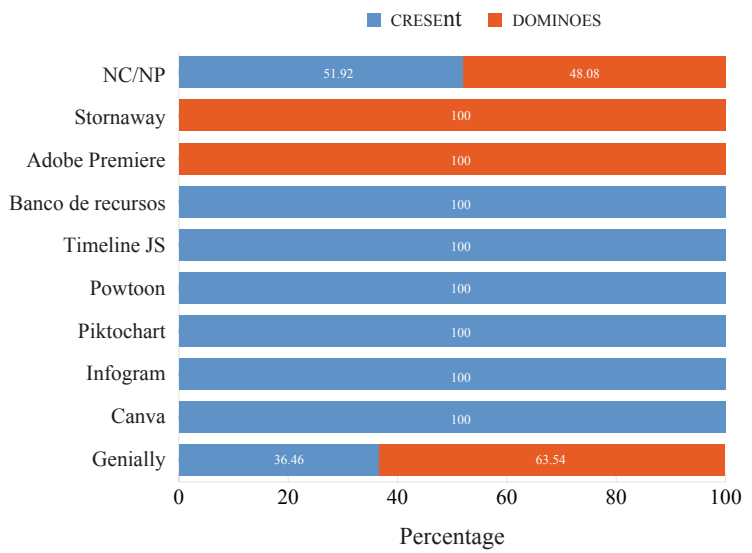
As for the DOMINOES MOOC, 61 products were created, consisting of 37 interactive presentations, 9 videos and 15 activities. Figure 4 shows a comparison of the tools used to develop the different products that comprise the MOOCs.

FIGURE 3
COMPARISON OF PRODUCT TYPE




Source: The authors.

FIGURE 4
COMPARISON OF THE AUDIOVISUAL TOOLS OF THE MOOCS




Source: The authors.

An analysis of the relationship between the product type and the production tool used reveals that all the presentations for both projects were created with Genially. As for the infographics in CRESCEnt, Genially (37 %), Canva (11 %), Infogram (15 %) and Piktochart (37 %) were used; while no infographics were used in DOMINOES. As concerns the videos, in CRESCEnt they were created exclusively with Powtoon, while in DOMINOES they were produced with Adobe Premiere Pro (67 %) and Stornaway (33 %).

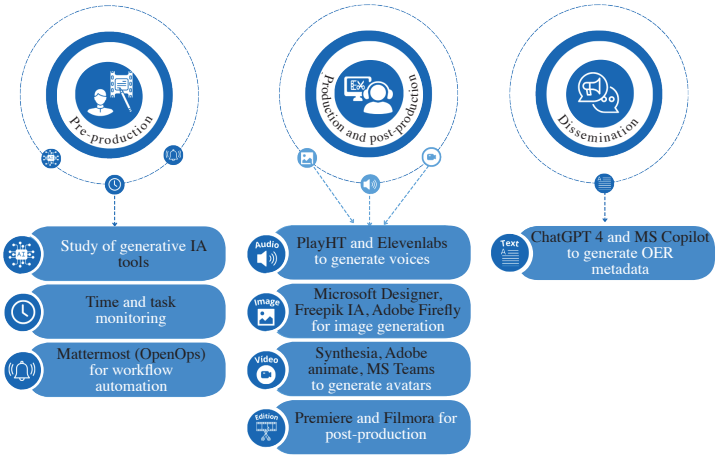
With regard to the types of products that make up the resources of the MOOCs, in both CRESCEnt and DOMINOES, the majority of the products include text. However, there is one significant difference in how videos are used in the two projects; in CRESCEnt, videos account for 12 % of all the resources, while in DOMINOES, this ratio stands at 50 %. Moreover, in terms of the source of the videos, 57 % of them in CRESCEnt are produced internally, while in DOMINOES, this figure rises to 83 %. 64 % of the resources incorporate interactivity in CRESCENT, 21 % with mouse-over and 79 % by clicking; and 87 % in DOMINOES, 26 % with mouse-over, and 74 % by clicking.

## Specific cases of production with AI

When the CRESCENT MOOC was being developed, from April to December 2020, there were no generally available GAI applications or tools that were applicable to audiovisual productions of this type; hence, they were not used. However, when developing the DOMINOES MOOC, which was done between June and October 2023, the use of GAI tools was included in the production planning, spanning various stages of the project, from the conceptualization of the MOOC to its publication. Figure 5 shows how AI was integrated into each phase of production and operation of the MOOC.

During the project's pre-production and monitoring phase, collaborative AI tools were used, such as Mattermost with OpenOps and Microsoft's Power Automate, to optimize the organization and automation of workflows. Given that the project spans several countries with teams of varying expertise in audiovisual and multimedia production, implementing the process automation, tracking the tasks,

FIGURE 5
INTEGRATION OF AI IN THE MOOC PRODUCTION PROCESS




Source: The authors.

personalized alerts, and the efficient management of files and resources led to a significant improvement in efficiency, reducing time and minimizing errors.

During the audiovisual production phase, various AI tools were used to ensure an efficient and professional production. These tools were essential to both creating unique products and developing multiple products. In fact, 48 % of the finished products incorporated elements created with AI. An analysis of how AI is integrated into the resources reveals that 45 % of the elements are fully integrated into the primary resource, 48 % are part of another resource, and 7 % are in both the primary and secondary resources.

Moreover, when examining the degree of AI integration in resources, whether for producing images, videos, and/or audio, we see that 69 % of the resources use a single AI element, 24 % use two, and 7 % use three. Of the AI-generated elements integrated into the resources, 55 % involve audio, 24 % still images, and 21 % video.

An analysis of what type of product features an AI-generated element reveals that 59.46 % of the interactive presentations include elements generated with GAI. In these presentations, AI is used for voice overs in 72.73 % of cases, still images in 40.91 %, and video avatars in 31.82 %.

With regard to videos, 100 % include AI-generated voices, 29 % include a video avatar and 14 % an AI-generated image. Figure 6 shows a selection of sample videos that relied on AI for their production.

FIGURE 6
EXAMPLES OF PRODUCTS MADE USING GAI

| Realistic avatar video created with AI | Interactive video with images created with AI | Video avatar with animation created with AI |
|---|---|---|


Source: The authors.

During the production phase, GAI tools were used for tasks such as voiceovers and subtitling videos, to remove backgrounds, and to produce images and graphic resources.

The use of GAI in the video editing applications enabled the development and integration of specific functionalities and tools. This had a significant impact on the efficiency and productivity of the production process, but, more importantly, it led to the introduction of new creative resources that enhanced the content quality. For instance, Filmora was used to edit or remove backgrounds (AI Smart Masking, AI Smart Cutout), Adobe Premiere for automatic subtitle generation (Adobe Sensei), Play.HT and ElevenLabs to generate English voiceovers (generative voice models like PlayHT2.0), Synthesia, Adobe Animate, and the MS Teams avatar engine to create realistic videos, and Microsoft

Designer, Freepik's AI-powered Pikaso engine, and Adobe Firefly to generate images.

The process of creating avatars not only saved significant time and costs compared to video production processes in DOMINOES versus CRESCENT; it also resulted in more, longer and higher quality video resources. In the final stage, which involved the operationalization, communication, and dissemination of the OERs, AI technologies were used to optimize the creation and ingestion of metadata into templates for the various open educational platforms where the resources were published (EPALE, Zenodo, and Digital Skills & Jobs Platform). In CRESCENT, the metadata was prepared manually. In DOMINOES, however, advanced tools like ChatGPT and Microsoft Copilot, powered by GPT-4, enabled the automation of metadata records specific to each platform, with a final manual review process. This process significantly shortens the time required to prepare the metadata and raises their quality, thus contributing decisively to improving the visibility and accessibility of OERS.

## Discussion and conclusions

The democratization of artificial intelligence (AI) is redefining paradigms in the field of audiovisual and multimedia production, prompting a fundamental rethinking of the creative processes. The gradual adoption of GAI tools in the production of OERs is indicative of their broader application in the audiovisual and multimedia field, as indicated by recent studies (Gutiérrez-Caneda et al., 2023; Túñez-Lopez et al., 2021). This represents a turning point in audiovisual and multimedia production methodologies, particularly in sectors like journalism and communication, as noted by Sánchez-García (2023), as well as in the models utilized to produce OERs.

The research has validated the two hypotheses posed. First, the integration of GAI tools (H.1) has been shown not only to increase the efficiency of audiovisual production, but also to significantly improve technical and formal quality and drive innovation in OERs. The results demonstrate how these tools facilitated the more efficient development of the DOMINOES MOOC, enabling the creation of more adaptive and interactive content while requiring fewer resources.

This made it possible to adopt production practices that are capable of addressing more complex audiovisual and multimedia solutions through GAI, which provides clear evidence that incorporating these tools not only enhances efficiency, but also improves the technical and formal quality while fostering innovation in the production of OERs. This is achieved by introducing new creative elements facilitated by GAI, such as avatars, automatically generated images, and synthetic voices.

Second, the technical capabilities of GAI tools (H.2) have been confirmed to offer a range of advanced functionalities, such as automatic audiovisual content generation and production process automation. This, combined with their growing availability and ease of use, makes them fully accessible and applicable to creative processes aimed at developing MOOCs, even with limited budgets. The use of AI in the DOMINOES production process enabled more cost-efficient planning and execution, reduced training time, and facilitated the team's adoption of the creative processes.

The results show that GAI tools have not only emerged as a viable option for developing educational audiovisual products, but they also herald the beginning of a disruptive phase, drawing on Christensen's (1997) perspective, in which the creation of audiovisual and multimedia content for MOOCs benefits significantly from GAI. The adoption of these technologies, which were still in their early stages in 2022 when the CRESCEnt MOOC was produced (Vega Jiménez et al., 2023), has demonstrated their ability to accelerate the production of multimedia resources, enriching courses with more adaptive and interactive materials boasting a higher technical and formal quality. These findings support the second hypothesis (H.2), which posited that the capacity and availability of AI-based audiovisual and multimedia production tools for MOOCs have significantly improved in recent years, making them more accessible and applicable to low-cost creative processes.

We conclude that there is a clear synergy between AI and creativity, which boosts the potential of artistic and creative teams by optimizing the pre-production, production, and distribution processes, a finding common to various studies (Anantrasirichai & Bull, 2022; Sarzi-Ribeiro & Sedeño-Valdellós, 2024). AI not only improves efficiency and lowers costs, but also raises the quality of educational con-

tent, confirming the findings of Pellas (2023). This evolution signals a paradigm shift towards more accessible and sustainable audiovisual and multimedia production practices, expanding the ability to produce high-quality advanced content that was previously unviable for low-cost educational productions due to its complexity and cost.

The research confirms the feasibility of a GAI-assisted serialized production model, setting a precedent for the efficient creation of OERs. The ability to generate content in various formats using GAI tools not only enhances the quality of the final product, but also sets limits on what expectations can be established for production frameworks during the development of these types of educational resources.

The exploration of the GAI tools developed in this research demonstrates their disruptive potential for content creation for MOOCs, offering universities and research centers new pathways for developing educational materials. However, the need for further research is evident, particularly on the empirical analysis of GAI's specific advantages in educational multimedia production, as highlighted by Morales-Chan et al. (2023), which could provide deeper insights into how to foster more inclusive and high-quality digital education.

As a result, this work not only validates the positive impact of GAI on the production of OERs, it also underscores the opportunity to continue exploring and innovating in the realm of audiovisual and multimedia production for education in digital contexts. This highlights the importance of adapting to and adopting these emerging technologies to improve and enrich the learning experience.

However, beyond the evident contributions of GAI to the creative processes of audiovisual and multimedia production, additional research using other approaches is needed to further analyze OERs so that recommendations can be developed regarding their properties and influence on learning outcomes in MOOCs.

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