



Leveraging Generative AI to Convert Web Learning Content into Open Educational Resources

Tirer profit de l'IA générative pour transformer les contenus d'apprentissage en ligne en ressources éducatives libres

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Abstract

This contribution aims to present the different stages of a design thinking methodological approach (Brown, 2009), which consists in training and using the ChatGPT generative AI model to analyze the content of a course's resources; extract and analyze the types of licenses used and the degrees of accessibility and openness of the resources; and assist in the process of transforming them into open educational resources. By focusing on this AI-assisted research method, we aspire to make it easier for educators and content developers to transform standard educational materials into open educational resources and present a practical case of generative AI orchestration, thus enriching digital education with AI.

Keywords

Artificial intelligence, orchestration, open educational resource, web content accessibility

Résumé

Cette contribution vise à présenter les différentes étapes d'une approche méthodologique de Design Thinking (Brown, 2009) qui consiste à former et utiliser le modèle d'IA générative ChatGPT pour analyser le contenu des ressources d'un cours, extraire et analyser les types de licences, les niveaux d'accessibilité et d'ouverture des ressources, et assister dans le processus de leur transformation en ressources éducatives ouvertes. En nous concentrant sur cette méthode de recherche assistée par l'IA, nous aspirons à faciliter la tâche des éducateurs et des développeurs de contenu pour transformer les matériels éducatifs standard en ressources éducatives ouvertes, et à présenter un cas pratique d'instrumentation de l'IA générative, enrichissant ainsi le domaine de l'éducation numérique avec l'IA.



Mots-clés

Intelligence artificielle, instrumentation, ressource éducative ouverte, accessibilité du contenu Web

Introduction

Open educational resources (OER) constitute a core dimension of the current open ecosystem (Class, 2023). Aligned with an intellectual approach that promotes the sharing of creative works, both to encourage their use and study and to enable their co-development and the creation of derivative works (Lourdin, 2024), OER initiatives emphasize openness and accessibility as advocated by UNESCO. The elements of openness and accessibility suggested by UNESCO aim to enhance the versatility of resources and their usefulness for consumers, as well as to facilitate the reuse, reworking, and repurposing of content, and its adaptation to local contexts (Chambers, 2022). Despite growing enthusiasm in professional and research settings, transforming existing educational resources (ER) into OER remains particularly complex, requiring a systematic methodological framework and partial task automation. The process involves preliminary exploration and cleaning tasks, such as content analysis and media extraction, to ensure resource reusability and shareability.

Recent advances in artificial intelligence (AI), particularly in generative AI (GenAI), have opened up new possibilities for supporting this transformation process. Models such as Copilot (Microsoft), Claude Instant and Claude 3 (Anthropic), and GPT-3 and GPT-4 (OpenAI), to name but a few, demonstrate remarkable progress in diverse tasks such as generating text and images, sound processing, and more (Karthik et al., 2023). Indeed, Gen AI encompasses multiple technologies, including machine learning, neural networks, and natural language processing. Machine learning, a subset of AI, develops algorithms that learn the same way humans do, improving over time as they process more data (Jhaji et al., 2024). It has demonstrated advanced capabilities in predicting the next word in a sequence, enabling the generation of coherent and contextually relevant text (Brown, 2009). Trained on vast datasets from the Internet, these models capture a wide range of linguistic patterns and knowledge, allowing them to perform tasks such as:

- Text generation: Creating human-like text for applications in content creation and chatbots.
- Machine translation: Translating text between languages with high accuracy.
- Summarization: Condensing large volumes of text into concise summaries.
- Answering questions: Providing answers to queries based on the information learned during training.

These programs, based on large language models (LLM), “have become increasingly sophisticated and convincing over the last several years” (Hicks et al., 2024, p. 1). While Gen-AI’s performance in various domains is promising, its critical analysis and complex skill combination abilities remain a subject of ongoing research. These models still struggle with tasks requiring deep contextual understanding or ethical reasoning (Marcus & Davis, 2020, p. 273). Their ability to make nuanced judgments or identify subtle patterns may not match human expertise in specific domains, primarily because human reasoning is based on a variety of stimuli, many of which are extra-linguistic (Hicks et al., 2024; Bender et al., 2021). Therefore, the nuanced understanding of context and the ethical considerations inherent in human decision-making are areas where human

analysts outperform AI. However, it is important to note that the field of AI is rapidly evolving, and new developments may shift the balance between human and AI capabilities.

Therefore, to take full advantage of these technologies, it is necessary to develop a good understanding of their detection, prediction, or automation functionalities so that they can be ethically and responsibly integrated into our practices (Miao & Holmes, 2023). Based on these assumptions, we conducted experimental research to leverage ChatGPT, a generative AI tool, to convert existing Massive Open Online Course (MOOC) materials into modular OER for widespread educational benefit. We summarize our investigation by postulating that it was possible to calibrate ChatGPT with appropriate instructions to:

- Conduct a systematic content analysis of multiple courses.
- Construct a list of criteria for the transformation of web content.
- Analyze levels of content openness and accessibility.
- Produce open, accessible, and copyright-free content.

To address these issues, we selected ChatGPT as it represented the pinnacle of LLM development (AI-PRO Team, 2024) at that time and still does today. Integrating this tool into the research process would, therefore, facilitate our work of exploring and analyzing each resource's license types and accessibility and produce documents that comply with visibility and accessibility standards for the benefit of **educational communities**.

Background, Rationale, and Ethical Positions

The MOOC to be transformed is taught in French. It aims to enhance the learner's knowledge of the vocabulary related to artificial intelligence – a vocabulary that is primarily known and used in English – so that the learner can apply it in their environment. This course is currently distributed via a distance learning university's platform in a semi-open format: it is free of charge, but it is part of an institution's framework and is protected by institutional access rights. In addition, participants are not free to reproduce or adapt the course content. Given the course's potential for French-speaking populations with low levels of artificial intelligence literacy, the project to make it free and accessible to everyone is particularly valuable. In the context of this project, the focus has been on transforming the ER related to key events in AI for each module of the MOOC. These are historical timelines containing a variety of educational resource formats, including text, video, audio, and interactive simulations.

As part of this project, the following assumptions have been made: ChatGPT could be used to (1) develop a repertoire of criteria to guide the analysis of the MOOC's educational web resources and their transformation into accessible open OERs, and (2) assist the team in the transformation process itself. The background section focuses on existing knowledge in 2023. In the context of the research carried out during the 2023-2024 period, OpenAI has established itself as a frontrunner, notably through its development of the GPT (Generative Pretrained Transformer) family (Shakudo, 2025). When GPT-3 was released in 2020, its 175 billion parameters represented a significant advance, positioning it among the most substantial models of its era. The next generation, GPT-4, has built on this foundation to deliver enhanced reasoning capabilities and deeper contextual comprehension (AI-PRO Team, 2024).

ChatGPT is one of the machines that can learn autonomously, through training, how to execute assigned tasks (Le Cun & Brizard, 2019). The GPT model, including the GPT 3.5 and 4 families

that we utilized within the framework of this research, comprises a family of cutting-edge language models developed by OpenAI. The GPT models have been trained on a vast corpus of diverse textual data comprising over 400 billion tokens, including books, articles, and web pages from various sources such as Common Crawl (which archives the Internet) and Wikipedia, all utilizing unsupervised learning techniques (Garbinato, 2023; Karthik et al., 2023). In other words, GPT's performance relies on its ability to reference a vast corpus of data and online tasks, coupled with its broad capacity to analyze these to generate responses.

However, ChatGPT remains a textual language model with predictive logic, trained with a specific instruction: to find the plausible next word based on a sequence of texts (Garbinato, 2023). Due to this probabilistic approach, the tool can produce errors, such as generating incorrect information or contradictory elements within the same conversation. Furthermore, since the model is trained on vast amounts of data that often reflect multiple societal biases, these biases can propagate in the generated content, thereby perpetuating and amplifying societal biases and prejudices (Karthik et al., 2023). Moreover, let us remember that even when ChatGPT demonstrates a superhuman ability to generate data (texts, schemas, diagrams) efficiently, we must acknowledge that the tool feeds on already existing texts and cannot produce innovative discourse. Therefore, it is not capable of creating OERs.

Despite its limitations, this artificial interlocutor can carry out a form of analysis based on a query and provide a structured response grounded in human reasoning (Raffin, 2023). In the context of this research, ChatGPT was mainly used to perform data preprocessing tasks such as exploration, classification, and transformation, but not to assist human reasoning. The essential point is knowing how to use it with the necessary critical distance to discern true from false in the list of generated information. As UNESCO (Miao & Holmes, 2023) specifies in its recommendations on using generative AI for teaching and research.

Usage processes should ensure humans' interactive engagement with GenAI and higher-order thinking, as well as human accountability for decisions related to the accuracy of AI-generated content, teaching or research strategies, and their impact on human behaviours. (p. 29)

The tool's inability to provide an absolute level of reliability for the information rendered (Bender et al., 2021) raised ethical questions in terms of both the choice of training data and the means of validating our work. Therefore, the principles of the theoretical frameworks related to openness and free access, as well as those enshrined in the web accessibility resources such as the Web Content Accessibility Guidelines (WCAG), were carefully adopted as the guiding framework for the work. In this respect, UNESCO suggests that issues of openness be considered as a set of practices that enhance resource versatility and usability, facilitating reuse, modification, and adaptation (Chambers, 2022). Open access "makes research discoverable, available, and reproducible for the advancement of science" (Open Education Global, n.d., Open Access section).

Theoretical Framework

Openness is intrinsically connected to the concept of the commons, as it promotes viewing a construct, creation, or existing entity as a shared resource – whether natural (a river), technical (a machine), or immaterial (software) – managed by a community that shares an interest in it and agrees upon a governance structure that democratically establishes collaborative rules (Zachariou, 2023). The notion of openness explored here aligns with commons on an epistemic level, since both emphasize a mindset rooted in sharing and collective construction for the advancement of the

community. That said, to return to our initial point, it becomes clear that OERs transcend the simple question of resources; they primarily represent a mode of conception and creation that promotes equal access to teaching, learning, and research materials, as well as the open sharing of these materials, and their support, with the entire community (Open Education Global, n.d.). In sum, everything is designed to promote sharing and contributions from a broad community to ensure the resource's sustainability.

A resource is considered open when the author specifies the rights to its use, which may or may not be free. In this way, an open resource indicates the level of the user license, informing the user of how the work must be used. A license is open when it respects the intellectual property rights of its holder and grants the public permission to consult, reuse, use for other purposes, adapt, and redistribute educational material. In this sense, OER refers to all learning, teaching, and research materials in any format and medium, in the public domain or protected by copyright and published under an open license, which may be consulted, reused, used for other purposes, adapted, and redistributed free of charge by others (UNESCO, 2019).

The digital accessibility of a resource, on the other hand, focuses on the channels and technical aspects that enable a wide range of individuals to access the resource. According to the World Wide Web Consortium (W3C), web accessibility, also known as digital accessibility, “means that websites, tools and technologies are designed and developed so that people with disabilities can use them” (Henry, 2005). Digital accessibility also benefits people without disabilities. That is why it is considered a universal approach. International rules guide the implementation of digital accessibility, the Web Content Accessibility Guidelines (WCAG), recommended by W3C.

In this project, these principles served as a theoretical framework to guide the selection of the data used to customize ChatGPT and analyze the responses generated in the orchestration process. Multiple parameters were taken into consideration, such as checking that course content complied with the website accessibility standard (SGQRI 008 2.0); verification of content accessibility; analysis of license types associated with external links or third-party resources; retrieval of data from free resources; and identification of suitable alternative resources. Our methodological approach mainly involved adopting a series of best practices for the ethical and responsible appropriation of the tool regarding these different parameters, aiming to generate reliable data. It was also important to mobilize a research protocol to validate the process. The various methodological stages of our research will be presented in greater detail in the following sections.

Methodology

This study used a design thinking methodology (Beudon, 2017; Brown, 2009; Gamba, 2017) to investigate how ChatGPT (versions 3.5 and 4, including the premium ChatGPT Plus model and relevant plugins) was orchestrated to transform an existing MOOC into Open Educational Resources (OER). The project involved five researchers with expertise in artificial intelligence, instructional design, computer science, web accessibility, and open educational resources. Out of respect for the principles of diversity, equity and inclusion (DEI), the team members were drawn from different disciplines, genders and cultures. The collective goals were to (1) explore and adapt ChatGPT's potential to assist in OER creation, (2) analyze the ethical implications of using premium AI tools, (3) design a framework for reliability, openness, and accessibility, and (4) refine the process through iterative prototyping.

In his book “Change by Design”, Tim Brown defines the design thinking approach in several keyways. He presents it as a set of principles that different people can apply to various problems.

It is a way of working that encourages the generation of many alternative ideas developed through sketching and prototyping techniques. It can be defined as a process of balancing innovation with the appropriateness for the social system addressed by the design problem (Plattner et al., 2011). Design thinking is an iterative approach, divided into distinct phases with their own objectives and cognitive patterns. Brown (2009) identifies three main phases, which should not be seen simply as successive steps: An inspiration phase, in which information is gathered from all possible sources; then ideation, in which this data is translated into ideas; finally, the implementation phase where the most promising ideas are developed into rigorously defined action plans (Brown, 2009). As Meinel & Leifer (2011, p. xiv) point out, design thinking is typically depicted as an iterative sequence of five main phases: (re) define the problem; need finding and benchmarking; body storm; prototype; test. However, this is the standard representation. The phases also overlap and are collaborative, inviting all project stakeholders to participate. Moreover, the adaptive expertise needed to identify relevant turning points and determine the appropriate next step represents a sophisticated intellectual activity that can be developed through practice and is teachable

The design thinking process requires higher-order intellectual activity, which demands practice and is learnable (Plattner et al., 2011). This underlines the importance of design thinking, in the context of this research, as an integrative, interdisciplinary, human-centred, and innovative approach that goes beyond product design to tackle broader, systemic problems. In the following section, we detail the steps of the design thinking approach, highlighting how ChatGPT was integrated into the process as a tool to assist the team in converting educational materials into OERs, focusing on accessibility and openness.

Although our original intention was to follow the classic sequence of Inspiration → Ideation → Implementation (Brown, 2009), practical considerations – particularly the need to calibrate ChatGPT repeatedly and address emerging ethical concerns – led to iterative deviations from the standard model (see Figure 1). Specifically, we revisited earlier phases multiple times to incorporate new knowledge (e.g., additional plugin features, newly identified ethical issues, and collaborator feedback). Our approach, grounded in design thinking, involved four key steps as illustrated in Figure 2. Each stage overlapped with and informed the others – for instance, new ethical or technical insights prompted revisions to earlier steps – demonstrating the non-linear and iterative character of design thinking in an AI-driven context.

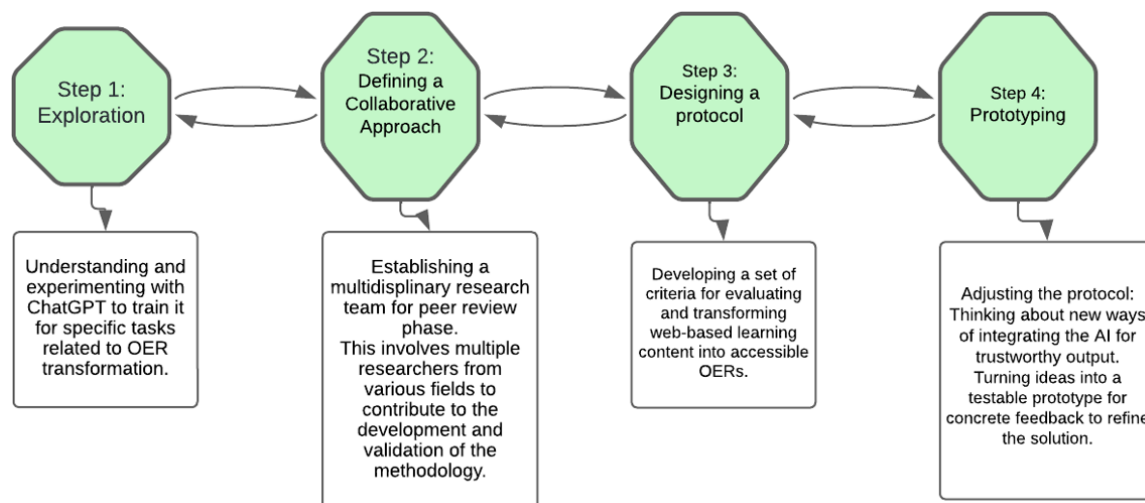


Figure 1
Design Thinking: Integrating ChatGPT in the OER Production Process

Application of our Design Thinking Process and key Results for Each Step

Step 1: Exploration and Appropriation

Initially, the tool was used for practical purposes, primarily to optimize our processes. This hands-on approach helped us explore its potential, understand its components, and evaluate its capabilities. As we used it, we gradually adapted the tool to better suit our specific needs. As part of this orchestration process (Rabardel & Samurçay, 2006), we developed several persona-based query scenarios to adapt the tool to our needs. We have to acknowledge that the tool used is monocultural. This limitation is part of a wider problem, where relevant knowledge remains invisible in the dominant discourse.

As part of this experiment, we used ChatGPT's custom instructions to create a mission to assist us in creating an OER based on the information provided to it:

Example of a mission:¹

You are Varia, an artificial intelligence developed by a university laboratory. You have been designed to analyze online learning web content and transform it into open and accessible Open Educational Resources to facilitate free access and sharing of knowledge. (E1)

Once the persona was created to guide the AI's actions, we opened a new chat to interact with the chatbot, which simulated the role of an OER expert.

Example of a query:

Hello Varia, I would like to analyze the content of an online course to transform it into an Open Educational Resource. Ask me all the questions you need so I know what key information to target in the course. (E2)

ChatGPT's answer:

Hello! To analyze the content of an online course to transform it into an Open Educational Resource (OER), it is essential to ask the right questions to identify the course's key elements and evaluate their relevance for OER conversion. Here are the questions to consider: (E3)

By framing our requests through these personas, we aimed to prompt the AI to recognize and adopt language patterns centred on openness and accessibility. This approach was designed to leverage the AI's learning capabilities, enabling it to acquire relevant knowledge and develop more sophisticated language skills per our objectives. We then tasked ChatGPT with creating an OER based on the information in these personas. Therefore, this first information provided by the AI was seen as a springboard to start building a data summary table, which would serve as a guide for analyzing a resource. Drawing on various sources in the current OER design literature, such as the UNESCO guidelines, we completed this table and trained ChatGPT to provide the correct answers for each course element. At each stage, we specified the tasks to be carried out and observed the tool's behavior. The tool's suggestions were processed, rejected, or validated each time. We then

1. All queries made during this phase of work with ChatGPT were written in French. In order to respect the main language of the article, the excerpts presented in the article (including in tables and figures) have been translated into English. To ensure transparency of the process, the original French versions of all these excerpts are available in appendix A.

carried out a more in-depth analysis of a section of the “*ligne du temps*” (timeline), and for this, we filtered and structured the knowledge base by indicating the specific concept to focus on. For example, we asked ChatGPT to indicate the language used in the “*Ligne du temps-Module 1*” educational resource. Then, to help the tool understand what analysis it is expected to perform when it comes to determining the language level of an OER, we specified the following:

Hello, I would like you to analyze the content of the file: Timeline AI from Yesterday to Today and determine whether the content is delivered with simple language and contextual details. Also, determine whether there is any substitute or additional content (graphics, illustrations) to facilitate understanding. (E4)

Table 1 shows the level of specification of the queries given to the AI and the quality of the answers generated, depending on whether the specificities are weak or detailed.

Table 1
Language Analysis Adopted for Each of the Missions

Indication	Content
First Mission: Iteration 5	Hello Varia, I would like to analyze the content of an online course to transform it into an Open Educational Resource (OER). Ask me all the questions that you need to know or that will help me target specific information to find in the course. (E2)
ChatGPT	Langue principale du cours : Français
Second Mission with Precise Analysis	Hello, I would like you to analyze the content of the document: “Timeline AI from Yesterday to Today” and determine if the content is presented with simple language and contextual clarifications. Also, determine if there are substitution or supplementary content (graphics, illustrations) to facilitate comprehension. (E4)
ChatGPT after analyzing the document “AI Timeline from Yesterday to Today”: Here are my observations regarding the language and presentation of the content	Language and Contextual Clarifications: The document uses relatively simple and accessible language to describe key events in artificial intelligence. Each historical event is accompanied by a brief description that provides contextual clarifications. These descriptions help understand the importance of each event in the evolution of AI. The technical terms are also well-explained concisely, ensuring that the content is fully comprehensible for the general public. Substitution or Supplementary Contents: The document includes supplementary images and graphics that illustrate the mentioned events. (E5)

These results confirmed our initial hypothesis that it is crucial to formulate detailed requests while being precise about the exact action to be performed. The effectiveness of the tool’s responses is strongly related to the user’s level of expertise. The user’s expertise enables them to validate the tool’s results and curate the training until the desired performance is reached.

This first phase was fundamental for understanding the tool, better targeting and defining our problem, analyzing the information collected to define a framework for action and formulating a problem/question.

Step 2: Defining a Collaborative and Participatory Approach

In this phase, we mainly defined the participatory approach of the various actors involved in this research. The research involved five researchers specializing in artificial intelligence, instructional design, computer science, web accessibility and open educational resources. Each researcher assumed a distinct validation role (e.g., “Accessibility Lead,” “Open Licensing Advisor”) to ensure thorough and diverse perspectives.

We also addressed the ethical bias posed by using the premium version of ChatGPT to produce OERs. Using ChatGPT Plus introduced inequities, as you must pay for access to this tool.

Nonetheless, it offered advanced features such as improved text handling (longer responses, image analysis) and plugin integration, deemed essential for a faster and deeper exploration of the MOOC's resources. We agreed that the tool would be inserted into our activity as an object to facilitate the resource transformation process. Our action was therefore geared towards getting to know the tool to use it effectively. The new ChatGPT Plus model is, in fact, capable of interpreting both text and images, analyzing the source code of an HTML page, analyzing and summarizing longer content than its predecessor, adding plugins such as Scholar Assist to consult scientific research databases, and sharing our individual GPT interactions among collaborators. This version of ChatGPT can adapt to its users' writing style to generate responses that match their expectations. It offered more control and enabled us to reach our goal more efficiently and quickly.

Step 3: Imaging – Designing a Protocol

This phase targeted and defined criteria for transforming web-based learning content into accessible OER. We fed the AI with the first summary table resulting from Phase 1 (training) and a set of information (URL links to official sites, reports, and articles) taken from the WCAG and UNESCO databases, which we adopted as guidelines. We also used GPT to explore other existing sources of information on the Web to enrich its memory. To generate a rich, inclusive, and replicable repertoire of criteria using a collaborative approach, we needed to build a protocol for use and a set of questions that would enable us to achieve consistent results. Once completed, the protocol was analyzed and validated. A protocol and a set of questions were also needed to justify the tool's predictive results. Indeed, the first data introduced trained the tool to have powerful language skills. However, with a protocol and a set of questions, it was possible to train the tool to generate more justified predictions, which could be compared.

The different results obtained by each team member were compared to ensure the reliability of our approach. Unfortunately, some questions were tested using different ChatGPT Plus features, resulting in answers with different tones. For example, questions 1 and 2 were tested with Scholar AI and Prompt Perfect in one case and without these plugins in the other. In Table 2, we can see that the answers provided differ according to the calibration given: the list of criteria is longer without the plugins, whereas each criterion provided is more detailed when the plugins are used. With plugins, the language structure is more elaborate, and the information is more concise. While the information is more generous, the language is shorter and less structured. The reference list is also different for some categories, but more generous without plugins.

The results provide evidence that connecting the chatbot with a database enables it to use the outputs of the database as text, which it then responds to and builds on. However, this can fail as the chatbot can “hallucinate”. Therefore, conducting both experiments was valuable for ensuring accuracy in the answers. By comparing our results at each stage of the work, we realized that the output was not contradictory but complementary. This was quite reassuring when it came to adopting the protocol. It emphasized that defining a framework and protocol for testing the reliability of the predictions produced must be a collaborative effort. It also highlighted the need for flexibility in the training method. We then built on this foundation to create a table richer in information from various sources. Drawing on everyone's expertise in open and accessible resources, we analyzed the lists of criteria, adding explanatory elements or other criteria deemed relevant. In this sense, it was important for the data in the table to be linked to the guiding principles of openness and accessibility. We created broad categories (Openness and Accessibility, for example) and sub-categories (Language, Instructional Design, Media, etc.) and grouped similar items in the appropriate sub-categories. We also checked the bibliographic reference links and supplemented them with other sources.

Table 2
Responses Generated Based on Calibration with or Without Scholar AI or Prompt Perfect

Criteria	With Scholar AI et Prompt Perfect Plugins	Without Scholar AI Plugin
Introduction	To create open, free, and accessible Web-based learning content, which is both inclusive and reliable, it is important to take several essential criteria into account. Here is a structured and detailed list of these criteria: (E6a)	The creation of open, free, and accessible Web-based learning content implies taking into account several essential criteria to ensure the content is effective, inclusive, and widely accessible. Here is a list of criteria to consider: (E6b)
1. Accessibility	<ul style="list-style-type: none"> – Compatibility with different devices: Ensure that the content is accessible across various devices (computers, tablets, smartphones). – Compliance with accessibility standards: Adhere to the WCAG guidelines for users with specific needs (e.g., subtitles for videos, textual descriptions for images). – Reference: No specific source found. However, accessibility standards are generally guided by the Web Content Accessibility Guidelines (WCAG). (E7a) 	<ul style="list-style-type: none"> – Compliance with WCAG (Web Content Accessibility Guidelines) to ensure accessibility for people with disabilities. – Use of transcripts for videos and textual descriptions for images. – Responsive design for ease of use across various devices (computers, tablets, smartphones). (E7b)

This work has allowed us to build an initial artifact comprising criteria for transforming web-based learning content into open and accessible educational resources. This directory has been designed to serve as an essential reference in analyzing and transforming the MOOC. The resulting guide can be viewed on Zenodo (Payen Jean Baptiste et al., 2024a).

Step 4- Prototyping: Turning Ideas into a Testable Prototype for Concrete Feedback to Refine the Solution

During the first step, we sought to analyze the degree of openness and accessibility of the MOOC Module 1 timeline web content by providing ChatGPT Plus with the course’s criteria table, HTML page source code and Cascading Style Sheet (CSS). Our initial objective was to orchestrate the tool to analyze educational website content independently, quickly identify points to be corrected and provide the necessary recommendations to make the content free, open, and accessible.

Unfortunately, the tool could not execute this request despite the calibration and level of reliable instructions received. For various reasons, it could only perform a partial analysis. Through several iterations, we observed that ChatGPT can analyze the accessibility of HTML and CSS source code, but only separately. In other words, “without being able to execute the code” (in its own words), it does not evaluate the influence or effect of a specific style on a corresponding HTML element. Since it does not run the code, ChatGPT cannot determine, for instance, whether there is sufficient contrast between two identified colours. In fact, when analyzing the CSS code, ChatGPT identified the text colour of a link and the background colour and suggested we check whether the two colours offer sufficient contrast, recommending online tools to evaluate this assessment. Similarly, ChatGPT recommended using “accessibility auditing tools”, such as Axe and Lighthouse, to “evaluate keyboard navigation and visual focus”. Furthermore, while the tool could identify non-shareable third-party resources, it did not suggest alternative resources.


As a result, we modified our procedure to find the best format to produce an open and accessible OER in accordance with UNESCO and WCAG standards. We asked GPT to recommend the most suitable formats based on the principles of openness and WCAG accessibility. In the following extract, you can trace our approach with a customized Expert Accessibility OER bot designed to meet our needs.


In addition, to analyze the license types and openness of all third-party resources in each timeline (e.g. bibliographic references, texts, and images), we designed a new custom chat named “*Ingénieur REL* (OER engineer)”, which we fed with our guide and other instructions (such as URL links to WCAG and Creative Commons licenses). This custom bot is configured to analyze the credentials of educational resources, provide recommendations about license types and suggest alternative resources for non-free and open licenses. It integrates four key skills:


- Analyze the accessibility of web content.
- Analyze the types of licenses in a reference list.
- Make recommendations for structuring content.
- Analyze third-party resources on a website.

The “Key Events in AI” timeline from the MOOC was analyzed using an iterative process. This involved evaluating the content’s accessibility and openness, identifying areas for improvement, and making adjustments and modifications. Unfortunately, the tool’s functionalities did not allow us to achieve our initial objectives, which were to use ChatGPT to assist in converting standard educational materials into OERs, emphasizing accessibility and openness. However, the experiment was helpful because the tool, given the appropriate calibration, made it easier to analyze educational resources, extract and analyze the types of licenses used, and assess how accessible and open the resources are, all within a reasonable time.

The following two images (Figure 2a and b) show the types of analysis that the bot can perform. In Figure 2a, the AI analyzes a source to indicate whether it is a royalty-free resource. In Figure 2b, the bot recommends the appropriate way to use the resource, indicating the correct form of citation.

a)  **Table of resources and licences analysis**

#	Ressource	Type	Source	Licence	Open ressource?	Recommendations
1	Vidéo "Yann LeCun - IA" (ARTE)	Vidéo YouTube	ARTE YouTube	Standard YouTube	 No	Look for alternative on Canal-U or PeerTube with CC BY licences

b)  **Recommended Attribution for Non-Free Resources**

#	Source	Recommended attribution	Comments
1	Vidéo ARTE (Yann LeCun)	Titre : 2 minutes pour comprendre l'IA – Yann LeCun Auteur : ARTE Source : YouTube - ARTE Date : June-20-2016 Mention : All rights reserved	Do not embed directly into your text. Use the link or provide a summary with citation.

Figure 2
Use Case Examples From Ingénieur REL

By employing design thinking iteratively and adaptively, the team navigated technical (AI limitations), ethical (premium model access, potential biases), and practical (need for repeated calibration) challenges. Despite deviating from the classic three-phase model (Brown, 2009) in sequence and duration, this flexible approach enabled a more profound, ethically conscious exploration of ChatGPT’s capacity to convert MOOCs into OERs.

Table 3 summarizes the various stages and the results obtained, including ethical considerations.

Table 3
Stages, Results, and Ethical Considerations

Steps	Goals	Key findings	Ethical considerations
1. Exploration and appropriation	To self-appropriate ChatGPT and explore its capabilities and limitations for analyzing and transforming web-based learning content into OER.	<p>Prompt specificity: ChatGPT performed better when provided with highly specific prompts and well-defined tasks.</p> <p>Memory Limitations: Although ChatGPT retains conversational context within a session, researchers needed to give frequent reminders about the task to ensure continuity.</p> <p>User Expertise: Researchers' ability to filter, reject, or validate ChatGPT's outputs was critical in refining the data.</p>	Bias and reliability: The team noted that ChatGPT might "hallucinate" or reinforce societal biases (Karthik et al., 2023). Researchers adopted a critical stance to detect and correct potential inaccuracies.
2. Defining a collaborative and participatory approach	To identify the research participants, roles, and collaboration protocols, including explicit ethical considerations surrounding the use of premium AI services.	<p>Team composition: Multidisciplinary perspectives improved the capacity to identify and correct ChatGPT's factual inaccuracies and ethical pitfalls.</p> <p>Plugins and enhanced capabilities: ChatGPT Plus with Scholar AI and Prompt Perfect offered higher accuracy and more concise output structures but still required human cross-checking to avoid "hallucinated" references.</p>	<p>Access and inclusion: Given the objective of the project, the team explicitly prioritized the performance of the tool, which required a paid version, as opposed to the free version, which offers access, admittedly more open and inclusive, but with lower performance.</p> <p>This difference emphasized the methodological priority of in-depth exploration.</p>
3. Imagine – Design a protocol	To develop and validate a protocol for using ChatGPT to (1) generate a broader OER transformation criteria list, (2) test accessibility, and (3) explore suitable content licenses.	<p>Plugins: Without plugins, ChatGPT produced longer lists of criteria. With plugins, it provided more developed and concise explanations, sometimes with "hallucinated" references. These were used in tandem to refine outputs.</p> <p>Collaborative validation: Repeated comparison of results by the five researchers was pivotal in eliminating inaccuracies and biases.</p>	<p>Bias and reliability of the tool: The risk of ChatGPT generating erroneous or contradictory data was recognized, leading to the implementation of a user protocol for the supervision, evaluation and validation of the data generated.</p> <p>Open or proprietary tools: Consideration of the use of the plugins offered and whether they can be open.</p>
4 Prototyping: turning ideas into a testable prototype for concrete feedback to refine the solution	To prototype a ChatGPT-driven system that analyzes the openness and accessibility of MOOC Module 1 materials, proposing actionable modifications to create OER-compliant outputs.	<p>Partial limitations: ChatGPT's inability to "execute" code or fully cross-reference HTML/CSS led to incomplete accessibility evaluations.</p> <p>Human oversight: Although ChatGPT accelerated some tasks (e.g., summarizing content, identifying license conflicts), final checks by human experts were indispensable.</p>	License compatibility and bias: ChatGPT's suggestions included incomplete references to open licenses, which required an ethical review of the responses generated. In addition, the team created a custom chatbot fed by the knowledge base built up through interactions with the tool. This tool was designed to process the information provided, analyze licenses and the level of openness, and make recommendations.

Overall, the methodology underlines the inextricable link between human expertise, open collaboration, and responsible AI utilization. While ChatGPT provided valuable assistance, particularly in summarizing content, automating partial tasks, and highlighting open-license considerations, its limitations underscore the continued necessity of human intervention and critical oversight when transforming educational materials into fully open, accessible, and ethically aligned resources.

Discussion and conclusion

This contribution aimed to present the various stages of our methodological approach, which consists of training and using the ChatGPT GenAI model to analyze course resources, extract and analyze licenses, assess levels of resource accessibility and openness, and assist the team in the process of transforming ERs into OERs. This research leverages the transformative potential of GenAI, specifically ChatGPT, to assist in converting standard educational resources into OERs, focusing on accessibility and openness. The purpose was to equip educators and content developers with practical tools and guidance for transforming standard educational materials into open educational resources and present a practical use case for GenAI orchestration, thus enriching our knowledge of the application of AI to digital education. Our findings underscore two critical points that directly feed into the broader argument for integrating AI into open education:

Enhanced Efficiency through Human-Centred Control

The research confirms that AI can significantly accelerate processes such as license analysis, content filtering, and preliminary checks for accessibility. By semi-automating these tasks, generative AI offers immediate gains in productivity for instructors, curriculum designers, and researchers. Nevertheless, the sustained involvement of human expertise remains both ethically and practically indispensable for validating information, identifying subtle biases, and producing OER aligned with UNESCO's guidelines (Chambers, 2022). This synergy supports the paper's overarching argument that GenAI tools are most beneficial when embedded within collaborative, human-driven frameworks rather than viewed as stand-alone solutions.

Fostering an Inclusive and Collaborative Approach to Open Educational Resources

Our experimentation demonstrates that integrating AI into a design thinking method fosters more dynamic and iterative conversations about designing, adapting, and disseminating OER. The necessity of recalibrating ChatGPT, and occasionally reworking entire steps, illustrates how AI can spark ongoing inquiry: new ethical issues or domain-specific challenges frequently led us back to re-evaluating earlier methodological decisions. In line with the paper's central contention, open education initiatives gain momentum when stakeholders – from content developers to policymakers – actively redefine processes in response to evolving AI capabilities.

Together, these observations reinforce the central argument that AI-driven transformations of educational content must be anchored in transparent, ethical, and collaborative methodologies to genuinely advance open education. While our findings confirm the potential for AI-assisted OER production, several methodological flaws have become evident and suggest essential avenues for refinement:

Reliance on a Proprietary, Premium Model

- Flaw: We employed ChatGPT Plus, a proprietary, subscription-based service. This conflicts, to some degree, with the open ethos central to OER.
- Implication: In future investigations, open-source AI tools should be considered to better align with the ideals of equitable and openly accessible education, while still comparing their performance against premium services.

Fragmented Technical Analyses

- Flaw: ChatGPT could not “execute” or integrate HTML and CSS code analysis to confirm real-time accessibility issues (e.g., colour contrast or dynamic content rendering).
- Implication: This fragmentation forced researchers to rely on external auditing tools (e.g., Lighthouse), highlighting a methodological gap. Subsequent research or developing specialized plugins could bridge this divide, yielding a more seamless workflow.

Risk of “Hallucinations” and Inconsistent Output

- Flaw: The lack of internal code execution and the model’s probabilistic nature led to potential inaccuracies and “hallucinations”. Additionally, results varied depending on the calibration (e.g., presence or absence of specialized plugins like Scholar AI).
- Implication: Future projects could incorporate robust validation protocols (e.g., cross-referencing results among multiple researchers, re-checking references and URLs) to mitigate AI-induced errors and bolster reliability.

Inconsistent Prompting and Human Dependence

- Flaw: Researchers found that ChatGPT required extensive “prompt engineering,” and that even slight variations in instructions produced divergent, and sometimes contradictory, results. Moreover, AI’s outcomes remained heavily dependent on human coherence and ethical discernment.
- Implication: This underscores a training paradox: while AI can streamline tasks, it demands advanced user expertise to avoid misinformation. Future methodology might include standardized prompts and thorough documentation of each iteration to enhance transparency and replicability.

The research demonstrates that a human-AI collaboration can accelerate and improve the transformation of educational materials into OER, while highlighting the multifaceted limitations of current AI technologies. While instrumental in structuring our process, the design thinking methodology required repeated, non-linear adjustments to tackle ethical concerns, technical boundaries, and collaborative complexities. Building on these findings, future work should explore other AI tools and investigate their application across various contexts and disciplines. The contribution of a multi-disciplinary and inclusive team proved valuable in our case, suggesting that cross-disciplinary perspectives are essential in the creation and analysis of OER. In addition, continuous improvement and updates to chatbots will be necessary to enhance their effectiveness, particularly considering technological and scientific advances. It will also be essential to standardize, and document prompts to reduce inconsistencies, while still harnessing the creative potential of iterative, dynamic interactions with generative AI. In conclusion, although AI has demonstrated promising capabilities, human intervention remains essential. AI cannot replace

contextual understanding and human critical thinking. Combining AI with human expertise is crucial to ensure ethical and equitable practices and maximize its use, particularly in OER.

Notes

Data Availability

The data supporting the article and collected during the research hereby described are not available, in part for ethical considerations. However, a research protocol and two sets of questions are freely available on the Zenodo repository (Payen Jean Baptiste, 2024b, 2024c).

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