



Artificial Intelligence Use to Empower the Implementation of OER and the UNESCO OER Recommendation

RESEARCH ARTICLE

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ABSTRACT

Artificial intelligence (AI) has recently been gaining ground, particularly since November 2022, with the introduction of generative tools based on natural language processing and neural network algorithms. These kinds of tools have great potential for creators and users of Open Educational Resources (OER) and the Open Movement itself but they also represent risks. The International Council for Open and Distance Education OER Advocacy Committee (OERAC) developed two workshops to present the role of AI in OER at two international conferences in the fall of 2023. The workshops presented the features, benefits, key challenges, and practical issues related to using AI technologies from professional, ethical, sustainable, and equitable perspectives, while also focusing on the five areas of the UNESCO OER Recommendation. Participants were dynamically engaged in discussions, and documented their ideas in formats that could be used as OER in themselves. The OERAC noted and categorized the results, and developed short summaries and drafts for further work. Finally, drawing on the findings from the workshops, we asked ChatPDF for a second opinion on further suggestions for AI in connection with OER, which in turn related to the five areas of the recommendation. We conclude that, while there is great potential for the use of AI in the context of the Open Movement, there is also a need for professional ethics, equity, and sustainable capacity building, access, inclusion, policy, models, and international collaboration.

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The use of intelligent tools and Artificial Intelligence (AI) systems has become a reality that is integrating natural language processing and neural network technologies into our everyday lives and work. These tools demonstrate considerable potential to democratize knowledge by facilitating access to information and providing new pathways for personalized teaching-learning, adaptive assessments, and intelligent tutorials, also applicable in Open Education (OE) and Open Educational Resources (OER). It is noted that Generative Artificial Intelligence (GAI) tools have great capacity to save time and effort for creators of OER (Cox et al., 2024).

However, introducing AI to educational praxis does not happen without some complexity and challenges. UNESCO has been instrumental in crafting ethical guidelines and standards for the use of AI technologies. In November 2021 all 193 member states adopted UNESCO’s ‘Recommendation on the Ethics of Artificial Intelligence’ (UNESCO, 2022). In addition, recognizing the importance of education and capacity building in fostering AI literacy, and to support rapid and adequate AI integration into education, UNESCO published an AI Competency Framework Draft (UNESCO; 2023) for teachers and students, as shown in Figures 1 and 2.

The two AI Competency Frameworks for teachers and students play a crucial role in guiding both teachers and students to navigate the use of AI in education. As described in Figure 1, the guidelines support teachers and build their AI competencies for high-quality educational practice. Equally, guidelines in Figure 2 aim to ensure that students are equipped with the knowledge and skills essential in an AI- driven educational landscape.

Aspects	Progression		
	Acquisition	Deepening	Creation
Human-centred Mindset	Teachers are aware of the opportunities and risks AI presents in the educational context, based on understanding of human rights, social justice, and human values.	Teachers can integrate AI tools into their educational practices safely and responsibly, by taking into account national and local policies and prioritising the safety, privacy, and rights of all stakeholders.	Teachers can critically evaluate, reflect upon, and contribute to the evolution of AI in education, demonstrating a deep understanding of its societal impact, prepared for and engage in transformational actions to address the challenges of the AI.
Ethics of AI (throughout life-cycle of AI)	Teachers are aware and understand the importance of the fundamental ethical principles related to AI, recognise its human nature and the pivotal role of humans in the stages and considerations of AI development.	Teachers can critically assess and apply AI tools based on their ethical implications, uphold the values of equity, inclusion, diversity in educational use, communicate these considerations, and understand that design decisions of AI creators enable or undermine its ethical use.	Teachers can lead by example in their critical advocacy of the ethics of AI tools, promote an ethics of care and empathy in their use, and participate in communities for the iterations of institutional and societal regulatory environments.
AI Foundations & Applications	Teachers can recognize and are aware of fundamental AI concepts, demonstrating an understanding of how AI functions	Teachers can proficiently identify, evaluate, select, and apply appropriate AI tools based on specific educational contexts.	Teachers can demonstrate comprehensive proficiency in adapting or potentially modifying open-source and commercial AI tools to design solutions that cater to unique educational contexts.
AI Pedagogy	Teachers can identify the pedagogical benefits of specific AI systems, demonstrating an understanding of effective strategies for incorporating them in specific subject areas.	Teachers can adeptly employ pedagogical strategies in their use of AI, ensuring human-centric teaching.	Teachers can critically evaluate AI's role in pedagogical practice, design AI-enhanced transformative pedagogies.
AI for Professional Development	Teachers are aware of the potential of AI to support their continuous professional development and are motivated to use AI to engage in professional lifelong learning.	Teachers can proficiently use appropriate AI tools for participation in learning communities and collaboration to meet professional development needs across changing contexts.	Teachers can critically adapt, synthesise, or potentially modify AI tools to meet their own and their communities' transformative professional development across changing contexts.

AI competency framework for teachers (AI CFT) under development

Figure 1 Draft AI Competency Framework for teachers. (UNESCO, 2023).

We recognize that similar conversations and guidelines are being developed all over the world as educators grapple with how to approach the use of AI in learning and teaching (Ng, Leung, Su, et al., 2023). In this article, we refer to UNESCO’s competency frameworks, given their international collaboration and multi-stakeholder engagement to empower individuals and institutions through capacity building in AI literacy.

The ICDE’s OER Advocacy Committee (OERAC) who supports the development of the ICDE Global Advocacy Campaign for Open, Flexible and Distance Learning, including OER, hosted two workshops on the role of artificial intelligence (AI) in the context of OER: the first (W1) during the ICDE World Conference in Costa Rica (6–9 November, 2023) (ICDE, 2023), and the second

Figure 2 AI Competency Framework for students (UNESCO, 2023).

Competency Aspects	Competency Performance / Progression?		
	Understand	Deepening	Understand
A human-centred mindset (about people, society, environment)	Human Agency (fold in 'human thinking' - identifications of problems? Human accountability, guiding principles)	Human Accountability (Using AI to achieve personal goals; setting personal parameters/values; human-machine complementarity)	Citizenship in the AI Era (Humans as linked to technology, environment/sustainability, society, AI for the common good)
Ethics of AI	Critical reflections on AI (Military, security, hacking, bias/privacy/etc)	Safety and responsibility in AI (reflective use of tools, IP, privacy protection, misinformation, disinformation)	Ethics by Design
AI techniques and applications	AI Foundations Data, algorithms, and models (does this belong here?) plus exploring AI tools/applications, collaboration	Application Skills Programming AI techniques (engage/adapt existing models/systems to solve problems)	Creating with AI Modeling and visual representations plus creating with AI - Explaining the judicious use of AI they have learned in a given context
AI system design	Problem scoping How AI solves problems - comp. Thinking, design thinking (convergence of) Decision on whether to use a simple/complex model	Architecture design Method and system design, abstraction Designing with a human (domain expertise) Real-world datasets applied from public sources	Realization and iteration Algorithm realization; feedback loops

(W2) at the 31st Encuentro Internacional de Educación a Distancia in Mexico (27 November - 1 December 2023) (UDGVirtual, 2023).

The first workshop was presented in an innovative learning café format. The second workshop took place synchronously in a multimodal web conferencing environment using Padlet (https://padlet.com/rosa_ulloa/unesco-five-action-areas-omdr0444e6ydnlxo). The participants were involved in a collaborative dialogue to present their suggestions, comments, and questions.

This article presents results and insights from both workshops, during which we explored the characteristics, benefits, key challenges, and practical issues related to technology use from multiple perspectives, including professional, ethical, sustainable, and equitable practices.

Equally important to note is that the two events gave participants a unique opportunity to create a dynamic piece of OER that can be shared and disseminated. In this paper, we build on those workshop outputs by presenting short summaries and notes for further work.

In the following sections, we begin by addressing the conceptual background, the themes, and the strategies for the workshops based on the five areas of the UNESCO OER Recommendation. After this, we summarize the results and findings. Finally, we got a second opinion from ChatPDF (<https://www.chatpdf.com/>) to enrich suggestions on opportunities for further work.

CONCEPTUAL BACKGROUND FOR THE WORKSHOP

WORKSHOP TOPIC 1: OPEN EDUCATIONAL RESOURCES AND THE UNESCO RECOMMENDATION ON OER

The OERAC facilitators presented at the workshops the definition of OER as educational materials in any format and medium, free to reuse, repurpose, adapt, and redistribute, either in the public domain or under an open license (UNESCO, 2019). We also presented the UNESCO OER Recommendation set of values for promoting and protecting human rights, dignity, and environmental sustainability.

When preparing the theme on the five action areas of the UNESCO Recommendation, we used ChatGPT (<https://chat.openai.com/>) to enrich the topic and to provide a real example of the utility of the tool to build concepts and develop strategies. The outputs of the tool were presented to the participants.

The activity was designed to enable participants to reflect on how they advance essential principles such as transparency, accountability, and the rule of law online. The five areas emphasized in the Recommendation and framed during the workshops are:

1. Building capacity of stakeholders to create, access, re-use, adapt, and redistribute OER
2. Developing supportive policy
3. Encouraging effective, inclusive, and equitable access to quality OER

4. Nurturing the creation of sustainability models for OER
5. Promoting and reinforcing international co-operation

WORKSHOP TOPIC 2: ARTIFICIAL INTELLIGENCE

The facilitators introduced AI technologies by defining and framing them as follows:

AI technologies “...are information-processing technologies that integrate models and algorithms that produce a capacity to learn and to perform cognitive tasks leading to outcomes such as prediction and decision-making in material and virtual environments” (UNESCO, 2023, p. 10). This means that AI is grounded in computational models developed by individuals, such as machine learning, deep learning, and soft computing, among others ((UNESCO, 2023).

Thus, AI approximates reality and GAI tools today show creative capacities to improve human creative work. However, humans need to define AI use for educational goals, including for the creation and dissemination of OER.

Where AI and education intersect, DigiCo (2023) proposes a shared vision for AI models and education, placing students and teachers at the center, and considering six desirable qualities for AI tools to align with education: data privacy, alignment, explainability, reduction of biases, contextualization, and responsibility for transparency (Figure 3).

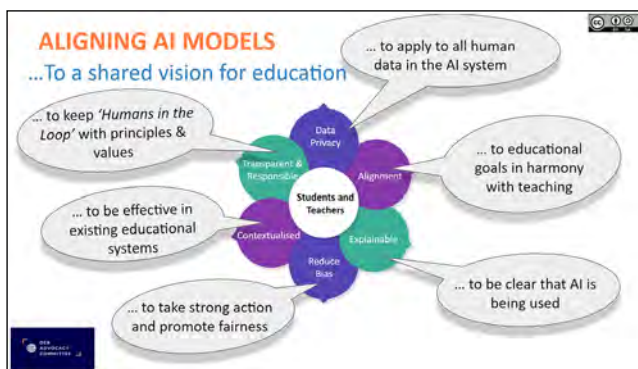


Figure 3 Adapted from The DigiCo model (DigiCo, 2023).

The DigiCo model was shared with our workshop participants. Also, we introduced UNESCO’s competency frameworks for teachers and students to guide discussions on AI implementation in the OER context.

In this article we acknowledge that GAI tools such as ChatGPT or Gemini, previously referred to as Bard (<https://gemini.google.com/?hl=es>) have great potential to help with OER development, saving time and effort (Lalonde, 2023), providing “an opportunity to demonstrate some of our best strengths, such as creativity and collaboration” (Mills et al., 2023, p. 17), and offering more options to scale up access to quality education (Gupta, 2023; OER Africa, 2023). By harnessing the power of AI, educators, and content creators can efficiently produce high-quality OER while improving accessibility, personalization, and overall effectiveness of open educational resources (OpenAI, 2022). Opportunities include:

- Creating more interactive and immersive learning materials and assessments (Gupta, 2023; Mhlanga, 2023)
- Tailoring materials according to individual learner needs and strengths (Cardona et al., 2023), through adaptive learning techniques, which, in turn, helps with student engagement and motivation.
- Recommending content of learning activities, based on what has worked well in similar settings, and/or lesson plans, based on those a teacher has used before (Cardona et al., 2023)
- Providing real-time feedback on self-paced learning (Gupta, 2023)
- Improving accessibility of materials and platforms through alternative input methods such as speech-recognition tools (Cardona et al., 2023)

- Translating and localizing openly licensed content (OER Africa, 2023)
- Highlighting patterns in a student's work using learning analytics (Cardona et al., 2023)
- Generating questions for learners
- Encouraging collaborative public annotation of different texts and resources
- Auto-tagging resources and generating metadata (Downes, 2021)
- Empowering learners to become OER creators themselves

The workshop participants were invited to propose and discuss strategies for implementing the UNESCO OER Recommendation (UNESCO, 2019), in light of the application of AI.

WORKSHOP TOPIC 3: AI CHALLENGES AND SUPPORT FOR OER

Another topic we addressed during the workshops was how using AI to create, access, re-use, adapt, and redistribute OER represents challenges (UNESCO Recommendation Action Area 1). For AI-enhanced OER to positively impact education, more collaboration is needed among educators, researchers, policymakers, and technologists while upholding principles of openness, inclusivity, and quality (OpenAI, 2022).

We prompted ChatGPT: ““What are the implications and challenges using AI with OER?”” Twelve suggestions were given in no order (OpenAI, 2022). These twelve suggestions were discussed with participants:

- Quality assurance
- Bias and fairness
- Customization and personalization
- Learner privacy
- Accessibility
- Lack of human touch
- Costs and sustainability
- Technical infrastructure
- Pedagogical integration
- Training and professional development
- Intellectual property and licensing
- Adaptability to diverse learning styles

We also prompted ChatGPT: “How can AI support the OER creation, use, and implementation?”. The OERAC facilitators provided participants with the list given by ChatGPT (OpenAI, 2022) below:

- Accessibility features
- Adaptive learning materials
- Auto-tagging and metadata generation
- Content enhancement
- Content generation, versioning, updating, and recommendation
- Data analytics
- Feedback
- Interactive simulations
- Language translation and localization
- Plagiarism detection
- Voice and speech recognition

METHOD

RESEARCH DESIGN

This work is grounded in Qualitative Research (QR) methodology, enabling researchers to explore insights and concepts regardless of numerical data or interventions (Tenny, et al., 2022). Within QR, a focus group is a popular research method that facilitates data collection on specific topics through group interactions in predefined research settings (Wutich et al., 2010). Focus groups can enhance the understanding of different perspectives on the same topic, which can be further detailed and reported. Therefore, focus groups as a qualitative data collection method was used to conduct this research.

'Wall of Wonder', Padlet, and field notes were used as data collection tools to protect the authenticity of participants' input within the dynamic research setting (2 workshops) and capture the key concepts and ideas that emerged from the rich discussions. Content analysis (Given, 2008) was used as a qualitative approach to data analysis, and cross-workshop thematic analysis was conducted to generate themes from the collected data.

All the computed data are available in an open format, following The UNESCO Recommendation on Open Science (UNESCO, 2022) and as OER:

1. Computed texts: [DataBase ICDE OERAC workshop 7 11 2023.docx](#)
2. Images from W1: [WallOfWonder](#)
3. Padlet from W2: https://padlet.com/rosa_ulloa/unesco-five-action-areas-omdr0444e6ydnlxo

When we were drafting the conclusions and recommendations for this work, we used the Findings section to feed ChatPDF (<https://www.chatpdf.com/>). The main purpose of using the ChatPDF was to compare the tool effectiveness to elaborate conclusions, draw implications, and suggestions. We did a similar exercise with ChatGPT.

As set out above, the OERAC facilitated two workshop settings, W1 and W2, to introduce participants to the five areas of the UNESCO OER Recommendation and fundamentals of GAI technologies applied to education; it also provided four perspectives for the use of AI, to foster creativity and discussion:

- (a) Professional.** Providing writing support for creating and drafting texts, checking spelling and grammar, and ensuring the use of plain language. In these terms:
 - (i) Find/check suitable sources.
 - (ii) Personalize learning for different contexts.
 - (iii) Encourage public annotation of different texts/resources.
 - (iv) Foster collaboration between learners and teachers, regardless of location.
- (b) Ethical.** Verify AI-generated content for accuracy, credibility and relevance. Promote transparency and critical thinking. Avoid replicating biases when using AI as a creative tool.
- (c) Sustainable.** AI promotes efficiency by helping to brainstorm, summarizing information, promoting discussions, providing real-time feedback, and suggesting learning pathways. It can also empower learners to be OER creators and improve digital literacy.
- (d) Equitable.** AI can provide supplementary reading/writing support and guarantee language accessibility by captioning and transcribing resources.

Participants engaged in collaborative dialogue, to provide input on the five areas of the OER Recommendation and on the use of GAI technologies. The researchers (facilitators of the workshops) closely observed the discussions amongst the participants and used field notes to capture key concepts and ideas occurring within these discussions.

W1 had 70 participants involved in creating a 'Wall of Wonder' with sticky notes. W2 had 25 online participants who contributed to a *Padlet* (Open Educational Resource Advocacy Committee [OERAC], 2023). Both the Wall of Wonder and the Padlet display the five areas (Figures 4, 6, 8, 10, and 12 as shown in the computed data links provided in the Conceptual Background Section) that also work as analytical categories.

The purpose of the 'Wall of Wonder' and the *Padlet* was to provide a format that the OERAC explored as focus-group data and as OER in themselves for further discussion and/or development in participants' communities.

The 'Wall of Wonder' and the Padlet show the fusion of various reflections; they resemble a complex and reflective collage of participants' understandings and interpretations of the topics. After inputting the texts, we used the content analysis technique (Given, 2008) to organize concepts, identify relationships, and make sense of them. We used predefined coding schemes based on the five areas of UNESCO's Recommendation on OER as primary categories and obtained meaningful dimensions (Gummer et al., 2018). Finally, we created word clouds to illustrate the collage of reflections (Figures 5, 7, 9, 11, and 13).

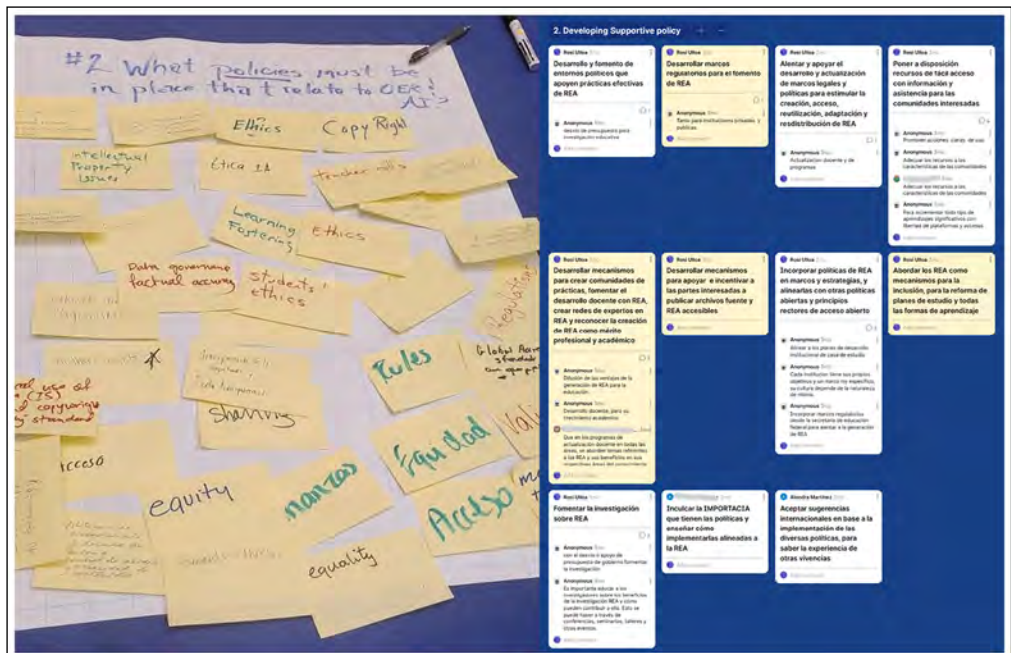


Figure 6 Sticky notes and Padlet Area #2 and GAI.

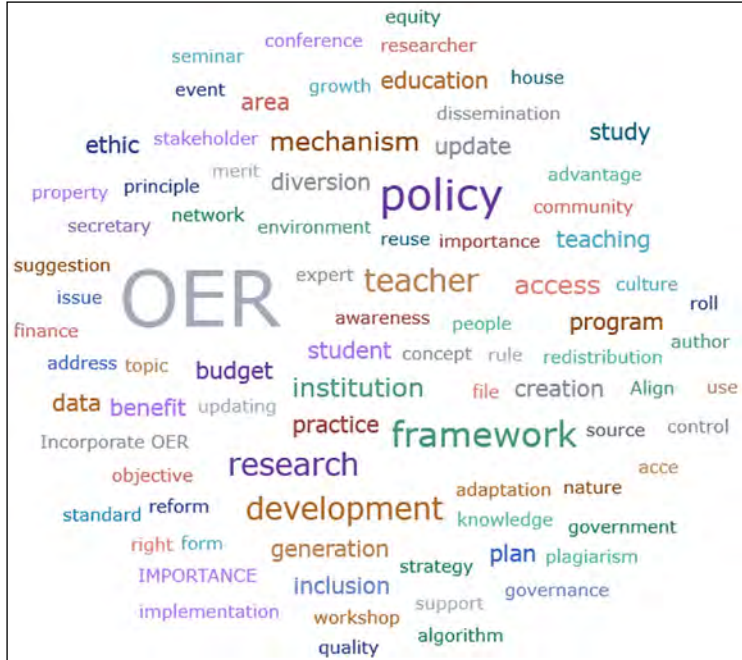


Figure 7 Word Cloud Area #2 on Developing Supportive Policy.

unesco-five-action-areas-omdr0444e6ydnlxo) for W2. The researchers’ field notes in relation to the collaborative discussions among the participants were discussed to cross-analyze the data sets. Answers relating to the five areas of the UNESCO Recommendation were clustered into a Wordle with one area per cluster.

We used ChatGPT as a tool to analyze the data sets of texts. The prompts we used are described in the following section.

FINDINGS AND DISCUSSION

OER and AI are rapidly advancing, highlighting the need to substantiate the paper through what was shared at two international conferences. The data from the two workshops were thematically cross-analyzed. Cross-findings were illustrated as word clouds related to each of the five areas in the UNESCO OER Recommendation, previously introduced in the conceptual background section.

FINDINGS FROM WALL OF WONDER AND PADLET

Below, each of the five areas are further described and supported by data figures. We used ChatGPT to identify the main themes from the participants’ insights.

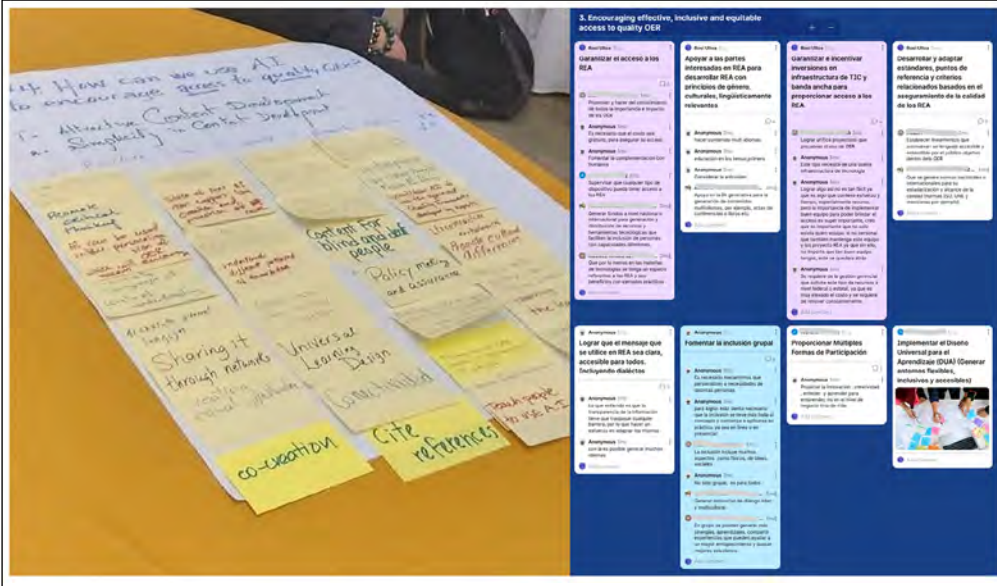


Figure 8 Sticky notes and Padlet Area #3 and GAI.

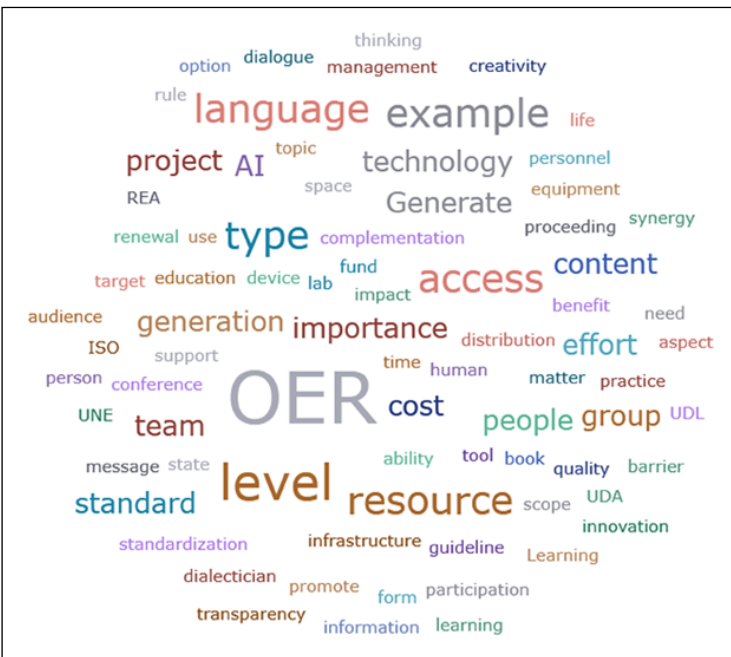


Figure 9 Word-Cloud Area #3. Effective, inclusive, and equitable access to quality OER.

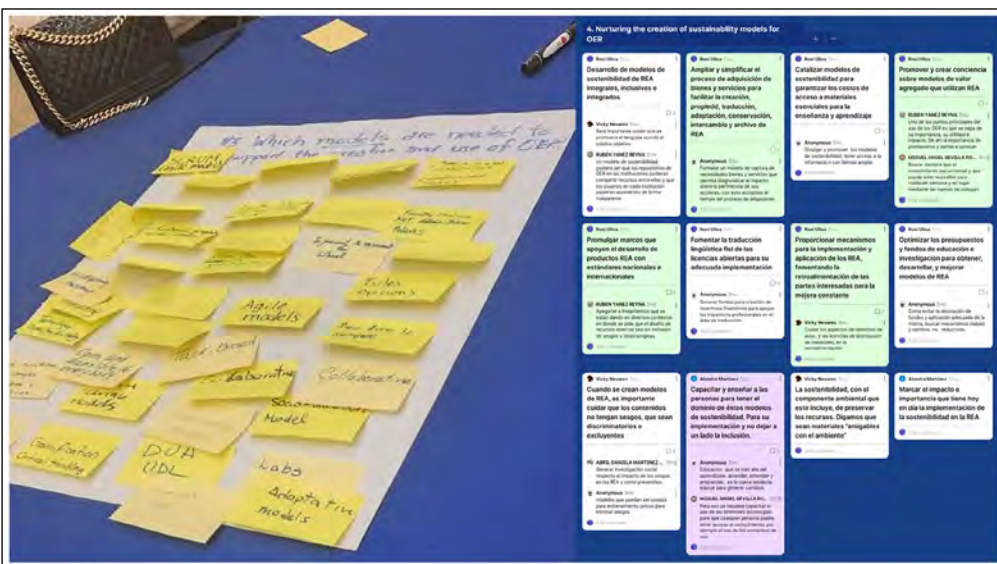


Figure 10 Sticky notes and Padlet Area #4 and GAI.

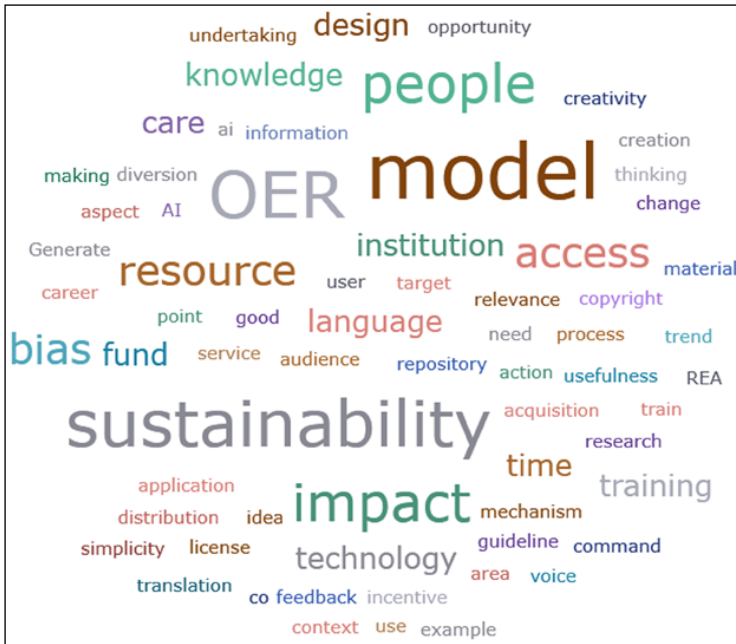


Figure 11 Word Cloud Area #4 Models needed to support creation, and use of OER.

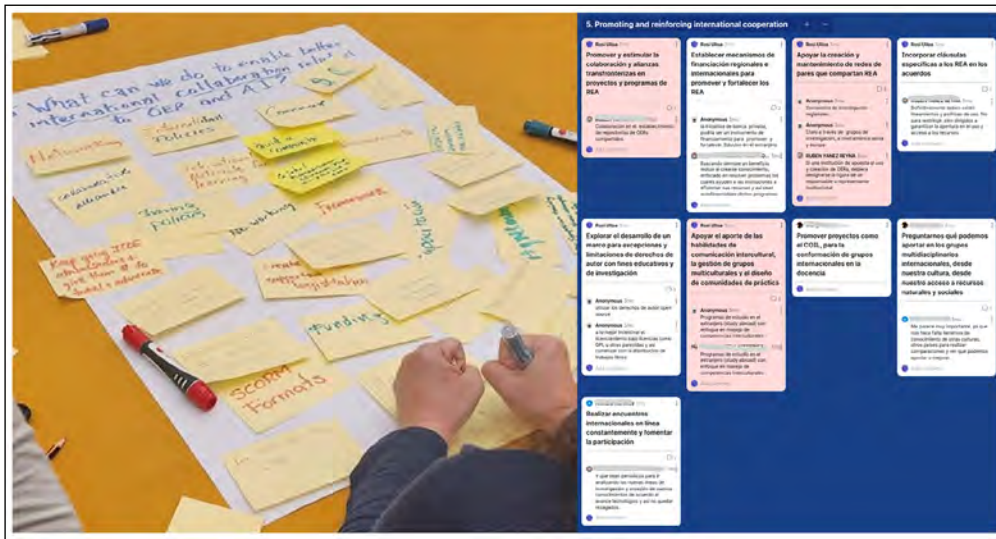


Figure 12 Sticky notes and Padlet Area #5 and GAI.

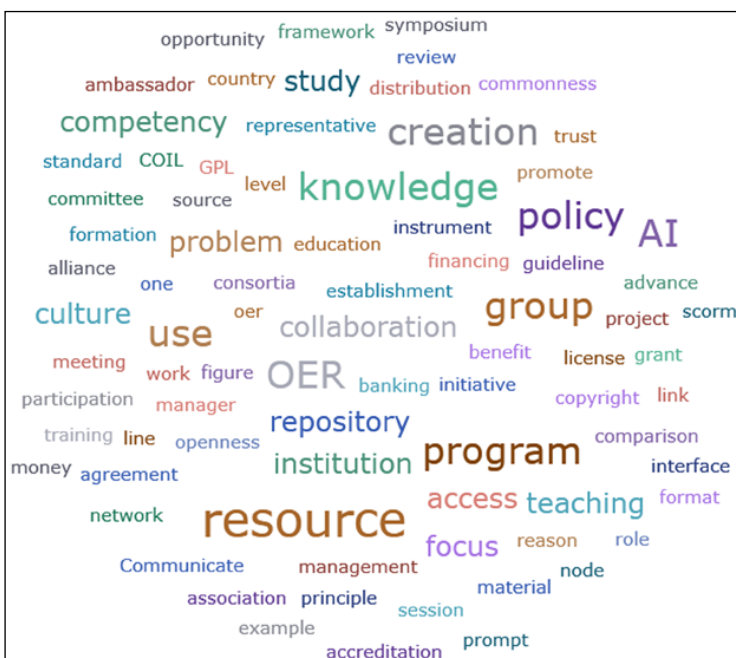


Figure 13 Word Cloud Area #5 on enabling Better International Collaboration.

Question 1: How can AI be used for capacity building (related to Area (i) Building capacity of stakeholders to create, access, re-use, adapt and redistribute OER)?

Participants' responses:

By using question 1 as a prompt, ChatGPT (OpenAi, 2022), found, for this area, three overarching themes:

- 1. Training:** for teachers, students, and stakeholders about OER creation, dissemination, and ethics. Skills such as critical thinking, problem-solving, and I were mentioned as strategic and for continuing education.
- 2. Resources:** identifying potential challenges, opening and sharing research (as a tool), and software.
- 3. Technology:** availability, updating, and maintenance.

By cross-analyzing the notes on the field, we discovered that the first two themes are related to knowledge and understanding of OER, whereas the third is linked to OER dissemination, information management, seeking, and transfer.

Question 2: What policies must be in place that relate to OER and AI (related to Area (ii) Developing supportive policy)?

Participants' responses:

From question 2 as prompt, the ChatGPT analysis on this area highlights four themes as policy approaches:

- 1. Inclusion:** diversity, organizational culture, openness to new ideas, and global perspective.
- 2. Laws:** to set legal frameworks for OER, recognition, professional development, and national and international cooperation.
- 3. Open Access:** (of) educational resources, technologies, and infrastructure.
- 4. Professional Development:** community building, networking, publishing, and recognition.

According to our notations of the workshop, these discussions focused on copyright and intellectual property, whereas access, ethics, quality assurance, equity, and standards were related to the four themes above.

Question 3: How can we use AI to encourage access to quality OER (related to Area (iii) encouraging effective, inclusive, and equitable access to quality OER)?

Participants' responses:

By using question 3 as a prompt, for this area, ChatGPT identified three themes:

- 1. Education:** which should include personal growth, collaborative learning, and knowledge sharing. AI is a tool to promote creativity and innovation in teaching, learning, and professional training.
- 2. Inclusivity:** As related to equity, equality, diversity, and accessibility of OER; AI is expected to help achieve quality standards and target specific audiences to prevent discrimination.
- 3. Project Management:** Including costs and funding, research support, resource allocation, maintenance, and accountability of OER projects.

In correspondence, our notes on the field pointed OER project management to achieve inclusiveness within a quality framework, and standards as requirements for OER models. All these topics were AI-related, that is considered a tool to provide and improve these features on OER by the participants.

Question 4: Which models are needed to support the creation and use of OER (related to Area (iv) nurturing the creation of sustainability models for OER)?

Participants' responses:

We used question 4 as a prompt for this area, five themes emerged, according to ChatGPT:

1. **Accessibility:** Creating inclusive OER, supporting multi-language content generation as a goal enabled by AI, effort, and collaboration.
2. **Sustainability:** Environmental conservation and preservation of OER.
3. **Advancement:** Career advancement, skills, language skills, progressive education, promotion.
4. **AI:** As a tool to explore, enhance, and promote sustainability, inclusion, collaboration, equity, skills, and education.
5. **Resources:** Technology advancements that enable knowledge sharing, resource allocation, and management.

In our notes on the field, the importance of effort and collaboration emerged as important AI sub-themes expressing participants' hopes on how AI can increase and facilitate inclusion in a non-reductionist way.

Question 5: What can we do to enable better international collaboration related to OER and AI (related to Area (v) promoting and reinforcing international cooperation)?

Participants' responses:

For this area, we prompted ChatGPT with question 5, and the tool clustered four themes:

- **Continuous learning:** as means to education efficiency through OER and AI, by encouraging participation in global training programs.
- **Efficiency:** This is achievable by sharing distribution networks, resources, programs, software, and tools.
- **Operations:** Strategies suggested to foster the ICDE doctoral symposium, UNESCO common principles and frameworks, and SCORM standards.
- **Regulation:** Participants suggested exploring global accreditation of related OER Skills.

In accordance with our field notes, the participants understood 'International Collaboration' as being cross-cultural, global, and multidisciplinary, achievable by holding international networks, online education, research, and meetings. Distribution networks are a must and are the means to foster international collaboration.

DISCUSSION ON HOW CAN AI APPLICATIONS PROMOTE THE FIVE AREAS IN THE OER RECOMMENDATION?

Area #1 Building capacity of stakeholders to create, access, re-use, adapt, and redistribute OER

Participants in both workshops agreed and highlighted the use of AI as a tool to improve not only OER creation but also sharing and maintaining of OER, following Nguyen's (2023) recommendation that fellow educators "approach new technologies with confidence and curiosity" (p. 8), and explore the opportunities that AI tools allow for teaching. This can only be achieved through the proper promotion of both OER and AI tools and their interactions.

Generative AI tools are available and valuable for strengthening our creativity, collaboration, sharing, and OER productivity. However, there is still a great need for capacity building and raising-awareness. On the other hand, reusing, adapting, and redistributing OER were not fully discussed, nor were the ways in which AI might help with these tasks, which emerged as a future research topic.

Area #2 Developing supportive policy

Open Educational Resources (OER) have reached global levels of development. The importance of using OER was particularly highlighted during the global COVID-19 pandemic, with most countries encouraging the use of OER in their educational networks (Bozkurt et al, 2020). Evidently, for this to be implemented, we must think about digital and social inclusion, laws, and professional incentives and recognition, in addition to a strong policy to publicize the use of OER and praising its benefits.

A major part of the discussions revolved around concerns regarding data privacy, ownership, copyright, open licensing, and security risks. Those are topics that international laws, regional

agreements, and institutional policies must address. There are also ethical questions about academic integrity, transparency, and trust (Cardona et al., 2023) which training programs and policies must tackle.

Area #3 Encouraging effective, inclusive, and equitable access to quality OER

The academic literature and the United States Office of Educational Technology - within the Department of Education - agreed to maintain “humans in the loop as a critical criterion for educational use of AI” (Cardona et al., 2023, p. 53). Our workshop participants also agreed that materials created through AI “become the first draft and that humans are then the revisitors” (Lalonde, 2023, p. 10). In addition, the participants highlighted the need for “knowledgeable humans” (p. 10) to check the credibility, relevance, inclusiveness, and accuracy of the content, as well as any unintended biases or misrepresentation.

There is also unease about whether AI might intensify the existing digital divide across different socio-economic and geographic contexts (OER Africa, 2023). As Shilling (cited in Shean, 2023) suggests, “AI brings educational technology to an inflection point. We can either increase disparities or shrink them, depending on what we do now” (para. 11). Given that the Open Education community seeks unequivocally to remove barriers to education, Stacey (2023, *Open Recommendations Across the AI Ecosystem section*) calls for “already existing open practices including Open Access, Open Data, and Open Science [to] be default norms and practices for AI research and development, [and for] publicly funded AI research and development [to] include requirements for open”.

Area #4 Nurturing the creation of sustainability models for OER

It is crucial to guide students and teachers in building their AI literacy (World Economic Forum, 2022) and to empower them to discover how AI can help them learn and teach (Downs, 2023; Nguyen, 2023). Therefore, educators should not ignore or overlook new technology options but rather embrace their affordances, critically assess their limitations, and engage in theory-informed design for effective pedagogical usages.

Also, AI can be a means to learn autonomy; thus, sustainable Generative AI systems can facilitate designing models to create, access, re-use, adapt, and redistribute knowledge.

Area #5 Promoting and reinforcing international cooperation

AI can enhance international cooperation. It is important to recognize context, languages, and cultural concerns: collaboration and networking are always based on trust, recognition, acknowledgment, and mutual and digital understanding.

One way to achieve these goals is by engaging graduate programs, students, teachers, researchers, and stakeholders in common settings to enhance OER production, access, reuse, adaptation, and redistribution.

To promote engagement, and continuing this discussion, the OERAC created an online space to capture additional thoughts on potential challenges in using generative AI tools for creating Open Educational Resources (OER) content. Please feel free to contribute using the link provided below.

https://padlet.com/rosa_ulloa/unesco-five-action-areas-omdr0444e6ydnlxo.

DISCUSSION OF THE USE OF GAI TOOLS FOR TEXT ANALYSIS

ChatGPT was undoubtedly a quick and efficient way to overview the texts. It accurately categorized the topics, facilitating deeper human analyses and the identification of topics which is one fundamental and complicated task (Ryan G. & Bernard H., 2003). Also, it was helpful to cover literature interactions which is particularly interesting; we corroborated some OER theoretical corpus on the participants' opinions.

For this research, the ChatGPT provided new possibilities to handle data sets of texts in a more engaging approach.

In summary, AI has considerable potential for all five areas of the UNESCO OER Recommendation as it was stated by the W1 and W2 participants, and as ChatGPT identified. It is crucial to be both critical and to act with ethos (the OERAC, as a global community acknowledging the potential and limits), pathos (documenting with literature and data evidences), and logos (compelling to a more ethical and responsible use of OER and OE), to ensure we uphold professional principles. Thus the four perspectives mentioned above should be considered when implementing AI in the creation and use of OER. The four principles are professional, ethical, sustainable and equitable.

The OERAC is aware of the limitations of GAI tools. We recognize that these technologies have their strength in constructing texts, so making summaries and identifying and grouping topics can be relatively simple tasks. Therefore, it was also of interest to test the limits of these technologies when performing more complex cognitive tasks, such as answering questions that involve the development of strategies and recommendations. To do a final experiment on the effectiveness of the GAI tools and to elaborate on the conclusions from workshops that require addressing strategies, the authors used ChatPDF (ChatPDF GmbH, 2023) and ChatGPT. For the input, we used the full text of the FINDINGS AND DISCUSSION section and the following questions as prompts. The output of this experiment, with some editing by the authors, are the tools' conclusions.

SUGGESTIONS FROM CHATPDF FOR THE CONCLUSIONS OF THE FINDINGS

Prompt: From the themes on the document, what strategies can you derive from using AI for building stakeholders' capacity to create, access, re-use, adapt, and redistribute OER?

ChatPDF output:

“At least three strategies can be derived to use AI for that purpose:

1. Design training for stakeholders, such as teachers and students, leveraging AI to provide personalized learning experiences
2. Identify quality OER, research tools, and software through AI curation
3. Tasks automatization, data analysis, and enhancement of OER creation and distribution processes through AI technologies integrated into educational platforms.

In addition to these specific suggestions, it is important to recognize that AI can facilitate the design of models to create, access, re-use, adapt, and redistribute knowledge, thereby promoting sustainable Generative AI systems. Also, training should be focused on developing skills such as critical thinking, problem-solving, and information literacy to enhance stakeholder' abilities to engage with OER effectively. By engaging graduate program directors, students, teachers, researchers, and stakeholders in common settings, AI can enhance OER production, access, reuse, adaptation, and redistribution.”

Prompt: What do you think is the most relevant strategy to develop supportive policies that relate to OER and AI?

ChatPDF output:

“Among the strategies for developing supportive policies related to OER and AI outlined in the document, one of the most relevant strategies is the emphasis on Professional Development. This strategy involves implementing policies to support stakeholders' continuous learning and skill development in OER creation, dissemination, and ethics.

Professional development plays a crucial role in ensuring that educators, content creators, and other stakeholders are equipped with the necessary knowledge and skills to leverage AI in effectively creating and distributing OER. By providing training programs, workshops, and resources that address ethical considerations, academic integrity, and transparency in using AI-enhanced OER, stakeholders can enhance

their capacity to produce high-quality educational materials while upholding ethical standards.

Furthermore, investing in professional development initiatives demonstrates a commitment to promoting excellence and innovation in OER practices. By empowering stakeholders with the skills and competencies needed to navigate the complexities of AI integration in education, supportive policies can drive positive outcomes, foster collaboration, and contribute to the sustainable growth of OER initiatives.

Therefore, prioritizing professional development as a key strategy in developing supportive policies related to OER and AI can significantly enhance the quality, accessibility, and inclusivity of educational resources, ultimately benefiting learners and educators alike.”

Prompt: What plan can you derive from the use AI to encourage effective, inclusive, and equitable access to quality OER?

ChatPDF output:

1. **Accessibility Features:** Develop AI-powered accessibility features such as speech-recognition tools, text-to-speech capabilities, and alternative formats to make OER more accessible to learners with disabilities. By incorporating these features, educational materials can be tailored to meet the diverse needs of all learners, ensuring inclusivity and equal access to quality OER.
2. **Adaptive Learning Materials:** Design adaptive learning materials using AI algorithms that personalize the learning experience based on individual learners’ needs, preferences, and learning styles. By tailoring content and activities to match each student’s unique strengths and challenges, adaptive learning can enhance engagement, motivation, and learning outcomes, promoting effective access to quality OER for all learners.
3. **Metadata Resources:** Utilize AI to generate auto-tagging and metadata resources for OER content, making it easier for learners to search, discover, and access relevant educational materials. By automatically categorizing and organizing OER resources based on content themes, keywords, and learning objectives, AI can streamline finding and using quality OER, thereby improving access and usability for diverse learners.
4. **Ethical AI Use:** Ensure that AI technologies used in OER initiatives are deployed ethically, transparently, and responsibly. Implement guidelines and best practices for the ethical use of AI in education, including considerations for data privacy, bias mitigation, and algorithmic transparency. By prioritizing ethical AI practices, stakeholders can build trust, promote equity, and safeguard against potential biases or discrimination in delivering OER content.
5. **Project Management:** Implement effective project management strategies that leverage AI to optimize the coordination of human, technological, and infrastructural resources in OER initiatives. By integrating AI-driven project management tools and platforms, stakeholders can streamline workflows, enhance collaboration, and drive innovation in developing, disseminating, and evaluating quality OER, ultimately fostering practical, inclusive, and equitable access to educational resources.

By following this plan and leveraging AI effectively, stakeholders can harness the power of technology to advance the accessibility, inclusivity, and quality of OER, ultimately promoting equitable access to educational opportunities for learners worldwide.”

Prompt: From the document, what model do you propose to support the creation and use of OER, regarding the sustainability of OER?

ChatPDF output:

“A proposed model to support the creation and use of OER, focusing on the sustainability of OER, can include the following components:

1. **Environmental Conservation:** Incorporate practices that promote environmental conservation and the preservation of OER. This can involve using renewable energy

sources, sustainable materials, and eco-friendly production processes to create and disseminate OER. By prioritizing environmental sustainability, stakeholders can reduce their carbon footprint and contribute to a more sustainable future for education.

2. **Career Advancement and Skills Development:** Develop initiatives that support the career advancement and skills development of OER creators and users. This can include offering professional development programs, recognition for OER contributions, and opportunities for continuous learning and growth within the OER community. By investing in the professional development of stakeholders, the sustainability of OER initiatives can be enhanced through the retention of skilled contributors and the continuous improvement of educational resources.
3. **Effective Resource Allocation and Management:** Implement models that promote efficient resource allocation and management in OER projects. This can involve leveraging AI-driven tools for content generation, versioning, updating, and recommendation to streamline workflows, optimize resource utilization, and enhance the overall effectiveness of OER initiatives. By adopting efficient resource management practices, stakeholders can maximize their efforts' impact and ensure OER projects' long-term sustainability.
4. **Inclusivity and Diversity:** Foster a culture of inclusivity and diversity in creating and using OER by implementing models that prioritize accessibility, multi-language content generation, and collaboration among diverse stakeholders. By leveraging AI-driven tools for multi-language content generation and collaboration, stakeholders can ensure that OER initiatives cater to the needs of a global audience, promote cultural diversity, and facilitate knowledge sharing across borders. Embracing inclusivity and diversity can enrich the quality and relevance of OER resources, making them more sustainable and impactful in the long run.
5. **Collaboration and Networking:** Encourage collaboration and networking among stakeholders in the OER and AI communities by leveraging AI-driven tools for collaborative public annotation, knowledge sharing, and resource sharing. By fostering a culture of collaboration and networking, stakeholders can leverage collective expertise, share best practices, and co-create innovative solutions to common challenges in the OER ecosystem. Collaboration and networking can enhance the sustainability of OER initiatives by promoting community engagement, fostering partnerships, and driving continuous improvement in the quality and accessibility of educational resources.

By adopting this model that integrates environmental conservation, career advancement, effective resource management, inclusivity, diversity, collaboration, and networking, stakeholders can support the creation and use of OER sustainably, ensuring the longevity and impact of open education initiatives for the benefit of learners worldwide.”

Prompt: Select the most effective strategies to use AI to enable better international collaboration related to OER and AI?

ChatPDF output:

“The most effective strategies to use AI to enable better international collaboration related to OER and AI include:

- a. **Translation and Localization:** Utilize AI technologies for translating and localizing OER content to make it more accessible to international audiences. By leveraging AI-powered language translation tools, stakeholders can overcome language barriers and facilitate collaboration across diverse cultural and linguistic contexts, promoting cross-border knowledge sharing and international cooperation.
- b. **Cultural Insights:** Harness AI to provide insights into different cultural perspectives and preferences, helping bridge cross-cultural understanding and fostering collaboration among diverse international stakeholders. By analyzing cultural data and preferences, AI can facilitate the development of culturally relevant and inclusive OER content that resonates with global audiences, promoting mutual understanding and cooperation in the OER community.

- c. Professional Development Programs: Promote professional development programs that support stakeholders' training in OER creation, dissemination, and ethics, with AI as a verification tool. By integrating AI-driven assessment and feedback mechanisms into professional development initiatives, stakeholders can enhance their skills, knowledge, and ethical practices in OER development, fostering a culture of excellence and collaboration in the international OER community.
- d. Distribution Networks: Leverage AI to facilitate the creation of distribution networks for OER, enabling the seamless sharing of resources, programs, software, and tools across international borders. Using AI-driven content recommendation systems and distribution platforms, stakeholders can expand their reach, connect with global partners, and promote the widespread adoption of high-quality OER resources, fostering international collaboration and knowledge exchange.
- e. Global Training Programs: Support global training programs that enhance education efficiency, provide personalized learning experiences, and promote international collaboration in OER and AI. By leveraging AI technologies for personalized learning pathways, adaptive content delivery, and virtual collaboration tools, stakeholders can create engaging and interactive training programs that cater to diverse learning needs and preferences, fostering a culture of continuous learning and innovation in the international OER and AI community.

By implementing these strategies and harnessing the power of AI effectively, stakeholders can enhance international collaboration, promote cultural exchange, and drive innovation in the development and dissemination of OER and AI initiatives on a global scale.”

SUGGESTIONS FROM CHATGPT ON THE ROLE OF AI IN THE CONTEXT OF OER.

ChatGPT elaborated the following suggestions from our manuscript on the role of AI in the context of OER and each of the five areas of the UNESCO OER Recommendation:

#1 Building capacity of stakeholders to create, access, re-use, adapt, and redistribute OER

1. It was obvious that there is still a great need for capacity building and, in particular, raising-awareness.
2. Ideas about how to improve capacity building by means of AI may challenge the OER movement but also present opportunities to improve tools' accessibility and OER sustainability.
3. There is a need to increase awareness on the phenomenon of OER and the UNESCO OER Recommendation.
4. Concerns on heritage, ethics, sustainability, equality, and professionalism should be addressed.

#2 Developing supportive policy

1. Develop policies at different levels (macro, meso, micro, and nano).
2. Communicate policies and integrate them into institutions and organizations' daily work.
3. Align policies with national, regional, and local policies.
4. Policies should center on inclusion, diversity, and access.
5. Promoting publication and recognition of OER to achieve a common understanding and promote professional development, community building, and networking
6. Policies should approach clear copyright and intellectual property guidelines
7. Quality assurance, equality, and standards must be linked to policy approaches.
8. Benchmarking of policies is needed.

#3 Encouraging effective, inclusive, and equitable access to quality OER

1. The main points are that education, digital inclusion, and digital transformation, if appropriately managed, can guarantee OER to share knowledge, promote equity and digital transformation. Artificial Intelligence is present in personal and professional environments.

2. It is essential to understand how to use AI ethically, effectively and efficiently. To ensure that this is a reality, project management must encourage the matrix of human, technological and infrastructural resources; It is a way of innovating.

#4 Nurturing the creation of sustainability models for OER

AI can support development of sustainable models and analyze their respective affordances, etc.

#5 Promoting and reinforcing international cooperation

1. The approaches identified to achieve international cooperation were clearly represented by the four categories of action that emerged from the data collection: continuous learning; efficiencies; operational strategies; and regulation. However, for these to be effective, clear communication amongst all parties is an obligation, as well as the explicit value outlined to achieve a long-term, engaging participation and sustainable approach.
2. The establishment of distribution networks is key to reinforce cooperation, as are context-specific 'Communities of Practice and Learning'.
3. To enable effective engagement, the provision of digital recognition badges in support of OER skills development could provide regulation and opportunities, ensuring everyone involved operates to the same high standards when undertaking OER creation, thereby setting a benchmark for others to follow.

OVERVIEW OF CHATPDF AND CHATGPT PERFORMANCES

It is essential to embrace a critical approach for using AI (Bali, 2024). Aligned with such an approach, we critically analyzed the data generated by ChatGPT and ChatPDF in relation to the findings of the two workshops and their generated report that we fed into these two AI tools. As a result, it is concluded that the outputs of ChatGPT were mostly a summary of the original texts. In other words, there was no evidence of new discovery or deeper text analysis in the ChatGPT output. Nonetheless, the ChatPDF approach deems to be more elaborate than the ChatGPT approach, providing more elaborate texts, discovering subthemes, and involving deeper analysis of the topics in the document.

Notably, the input text for the analysis corresponds to the result of a previous analysis carried out by ChatGPT and the OERAC (See Findings and Discussion section). Even so, we identified a few coincidences in the texts such as in the last paragraph of the output in question 1, where ChatGPT simply copy-pasted the same wording with no further analysis, changes or elaboration.

The tools differed in rich and complex narratives, though ChatPDF performs more human-approach analytics than ChatGPT

IMPLICATIONS AND LIMITATIONS?

We found the two workshops to be a fascinating way to advocate for OER, and promote a space for discussion and reflection on the potential of AI in the development and application of OER. While the impact of this is yet to be tangible, the workshops represent an incredible opportunity to monitor the state of OER understanding and use, mostly, in Latino-america communities.

We also found the use of GAI tools, ChatGPT and ChatPDF helpful in preparing the workshops and analyzing the data collected. However, we must address these tools limitations.

In general, the tools generated adequate writing and easy understanding texts. However, in a scrupulous review, we identified the needs for adjustments and improvements, and compels us to use GAI tools critically. In addition, the debate about their use in the educational environment by students is needed to develop the highly desirable reading and writing skills at more sophisticated levels.

Another limitation of the tools relates to their weakness in copying and pasting the text practically without additional editing, which complicates the structure and originality of the different sections of the article. However, at this point, we conclude that ChatPDF outperforms ChatGPT to some extent.

We acknowledge that this work has some limitations. The analyses are restricted to the participants' inputs on paper or in the Padlets, as well as the knowledge presented on the topic. Due to the dynamic discussions in the two workshops, it was not possible to fully capture and transcribe those conversations. To address this limitation, the researchers used Wall of Wonder, Padlet and field notes as data collection tools to record the main emerging ideas from the participants' discussions and input. In addition, to further engage participants in the conversation that occurred in W2, we created a second Padlet for post workshop input, however, there was no contribution from the participants. Looking into ways to revive the participants' engagement and build on the already existing data would be valuable in the future.

Findings emerging from the thematic analyses of these ideas across the two workshops, addressed the research questions and provided valuable insights. The findings are a summary of key concepts that the participants value and recurrently emphasized. The dissemination of knowledge that arises from the educator participants, in this research paper, helps inform about AI in relation to UNESCO OER Recommendation and can be instrumental in policy making.

FUTURE WORK

As a result of this qualitative research, we proffer the following recommendations for future research. While we used ChatGPT and ChatPDF in this study, using other open GAI tools available on the Internet, may provide different perspectives and offer monitoring the advances and improvements of the two tools documented in this work. Moreover, future research to assess the participants' ideas in implementing the UNESCO OER Recommendation in an open praxis format may provide valuable input and further contribute to the praxis of OER.

DATA ACCESSIBILITY STATEMENT

The datasets generated and/or analysed during the current study are available in the Drive folder OpenPraxis, (<https://drive.google.com/drive/folders/1h9nDo1RQEf4DZP8G43f20VdM5m0NIUhx?usp=sharing>) and in Padlet UNESCO five action areas (https://padlet.com/rosa_ulloa/unesco-five-action-areas-omdr0444e6ydnlxo).

ETHICS AND CONSENT

Consent to ethical questions is obtained from the authors.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS (CRediT)

Ebba Ossiannilsson: Conceptualization, methodology, formal analysis, investigation, data curation, visualization, writing—original draft preparation, writing—review and editing. Rosa Leonor Ulloa Cazarez: formal analysis, data curation, visualization, writing, review and editing. Claire Goode: Literature review, writing and review. Chadia Mansour: overall editing, review,

and contribution to writing as needed. Cristine Martins Gomes de Gusmão: Introduction, methodology, writing and review. All authors have read and agreed to the published version of the manuscript”

AUTHOR NOTES

We used the WordCloud tool to create Figures 3, 5, 7, 9, 11 and 13. The Conclusion section contains the output generated by prompting the four questions reported in the Findings and Outcomes section in the ChatPDF AI tool.

Sections **Workshop Topic 3: AI challenges and support for OER, Findings From Wall of Wonder and Padlet, and Suggestions from ChatGPT on the role of AI in the context of OER** of this article were generated with the assistance of ChatGPT 3 AI tool (November, 2023)] and later edited by human authors. Also, section **Suggestions from ChatPDF for the Conclusions of the Findings** was generated with the assistance of ChatPDF AI tool (February 7, 2024) These sections were subsequently reviewed, critically edited, and validated by the human authors to ensure academic rigor and adherence to ethical standards. The authors also assessed and addressed potential biases inherent in the AI-generated content. The final content in these sections is the sole responsibility of the human authors.

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