Considerations for Generative Artificial Intelligence in the Development of Open Education Resources

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ABSTRACT

The production of open education resources has contributed to increased access to academic literature and enhancement of global digital competency. While these public domain resources are primarily used in instruction, learning, and assessment academically, they are also used for corporate training programs. A primary advantage of open education resources is the ability to reuse, revise, remix, retain, and redistribute materials. The recent advancements in multi-modal generative artificial intelligence technologies provide the ability to produce of text, speech, audio, image, and video content that can be used for open education resources. This paper provides an overview of the potential benefits, risks, and considerations associated with the use of generative artificial intelligence systems to produce and contribute to open educational resources.

KEYWORDS: Open education resources, artificial intelligence, generative artificial intelligence

Introduction

The production of open education resources (OER) has contributed to the significant improvement in the global access, availability, redistribution, and affordability of academic materials (Srivastava, 2023). The options to reuse, revise, remix, retain, and redistribute materials in the OER process are based on the permissions granted by authors and creators that eliminate certain restrictions and limitations associated with conventional copyright protections. Open access allows public domain materials to be viewed, retained, and distributed without cost or limitations. The open licensing of OER materials provides additional permissions for the reuse, revision, remixing, retention, and redistribution of materials. The benefits of OER have been recognized in public policy and law (Pub. L. No. 114-95, 123 Stat. 1802 (2009)) in the United States for providing availability and wide distribution of instructional content, tools, and processes. The scope of OER materials extends to the creation of textbooks, syllabi, lesson plans, worksheets, assessments, assignments, and other creative course content (Barrientos, 2024; Stanford University, 2024). The use of OER and Massively Open Online Courses (MOOCs) models have provided global and community learning opportunities to include corporate training to advance employee proficiencies (Sanchez-Gordon & Luján-Mora, 2015; Zamiri & Esmaeili, 2024). These public domain resources provide immediate access to training materials for basic skills development or as a foundation for advanced training courses.

The advancement of information and communications technology (ICT) has impacted the digital transformation process for the effective and efficient creation and use of digital technologies in education (Timotheou et al., 2023). These advancements have also provided the ability to accommodate learners with diverse learning styles and requirements. The development of open-source software applications and cloud-based platforms has modernized the process of creating, adapting, and sharing interactive digital and printed books and materials (Pressbooks, 2024). These platforms support open-source frameworks designed for content collaboration and interactive content development including the HTML5 Package (H5P) which supports the ability to reuse and share OER content by licensing (Srivastava, 2021).

Artificial intelligence (AI) and machine learning with enhanced processing capabilities for large data models support applications for learning and education. AI learning platforms have already been utilized to provide individualized learning with continuous assessment (Zamiri & Esmaeili, 2024). The introduction of generative AI (GenAI) provides transformative capabilities to improve content creation for faculty, researchers, and students in mathematics, physics, medicine, computer science, communications, art, drama, and philosophy (Liu et al., 2023).

Generative Artificial Intelligence

GenAI systems combine interactive conversational chatbot and natural language processing (NLP) technologies with a generative pretrained transformer (GPT) and large language models (LLMs). The combination of these technologies enables the rapid generation of text, speech, audio, image, video, and other resources and media using a chatbot as an interactive user interface.

The most prevalent general-purpose GPT language model currently available is OpenAI ChatGPT, which has both free (GPT-3.5) and paid subscription (GPT-4) versions that differ in performance, response time, parameters, content, and text and image generation capabilities. ChatGPT incorporates supervised and reinforced learning technologies for improved quality and performance (Zohery, 2023). In addition, GPT-4 provides structured data-to-text auto-generation features with content updates that are not currently available with the previous text-to-text versions. There are also advantages to the combination of general-purpose generative AI models with a specialized or proprietary LLM as developed by Perplexity that utilizes OpenAI

GPT and Anthropic Claude models for creative content and dialogue generation (Anthropic, 2024; Perplexity, 2024).

Information technology and services companies continue to integrate GenAI capabilities into existing and emerging products and services to enhance efficiency and effectiveness to include Microsoft Corporation, Google, and IBM. The ability of intelligent human conversational systems to generate new content, and enhance existing processes, and knowledge is illustrated in Figure 1 (Feuerriegel et al., 2024).
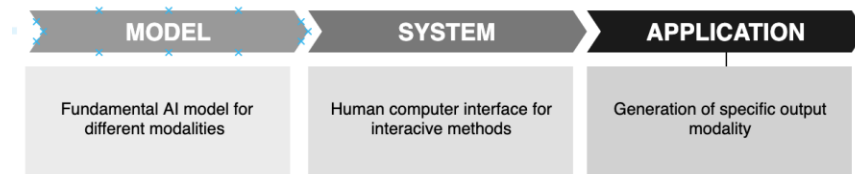

Figure 1: Model, System, and Application Implementation of GenAI
(Adapted from: Feuerriegel et al., 2024)

The adoption of GenAI systems for education, healthcare, finance, marketing, and other applications has resulted in the development of domain-specific capabilities to provide increased levels of accuracy, specificity, and performance. Selected general-purpose and domain-specific GenAI platforms and services are illustrated in Figure 2.
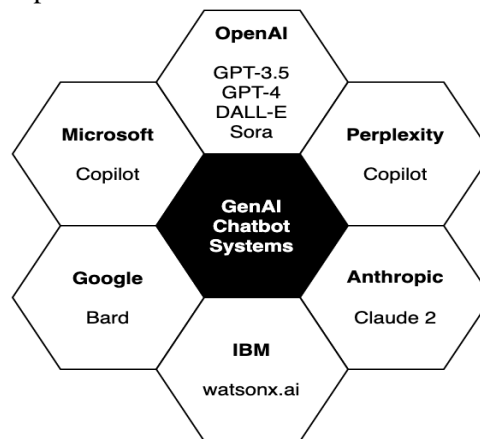
Figure 2. Selected Generative AI Platforms and Services

There are significant benefits of using GenAI for the writing, research, and publishing processes of OER materials and media in diverse subject areas. The algorithm and model selection of the Generative AI platform are optimally based on production requirements and objectives. As an example, OpenAI GPT-4 efficiently processes text and image input while Calude 2 is optimal for large amounts of text input (Perplexity, 2024). Multimedia requirements will benefit from the recent announcement of OpenAI Sora which is a text-to-video model capable of generating high-quality video output based on a simple text description.

Despite the accessibility, ease of use, and advantages of these technologies, there are several considerations for institutions and individuals concerning the use of GenAI to generate content to produce OER materials.

GenAI Content Creation for OER Applications

GenAI platforms process queries submitted to an interactive conversational interface that incorporates NLP to interpret and respond to user requests. These systems provide simplicity and speed that would otherwise require an extensive amount of time to research, identify, analyze, and refine specific content. This benefits students and faculty in research, writing, proofreading, and publishing with the following additional benefits to higher education (Cornell University, 2023; Zohery, 2023):

- *Instant access to large amounts of information*
- *Diversity in learning to include abilities, linguistics, and accessibility*
- *Expedite curiosity, creativity, and new thinking methods*
- *Development of course materials, lesson plans, learning objectives, and assessments*
- *Performance of research tasks and data analysis*

A basic understanding of the fundamental concepts of these systems and the parameters of the specific LLM is essential since GenAI technology has advanced from conversational chatbots with text output to the generation of complex visual multimedia content without any specialized equipment, knowledge, or skills. As an example, OpenAI Sora provides the ability to produce AI-generated content from a text description with detailed video accuracy and transitions while maintaining consistency and realism that will expand the number of potential applications for creating OER content in transdisciplinary fields that include storytelling, filmmaking, game development, and creative expression (OpenAI, 2024a).

The current focus of discussions and development of institutional policies has been on the use of GenAI technologies by students and the potential impact on learning effectiveness. There is also an increase in the use of this technology by faculty and researchers for instructional and research purposes. The use

of GenAI capabilities is expected to create on-demand content that will increase the availability of OER materials, but there are additional factors to be considered for the potential impact on academic integrity, critical observation and thinking, learning methods, and privacy.

GenAI Risks and Considerations

There are numerous risk factors that exist despite the defined benefits associated with the use, and incorporation of GenAI for OER content that should be evaluated to determine the impact of their use on users, institutions, and society. The selected risks included in this section provide awareness for the use of GenAI to develop OER materials:

Transparency

Principles attributed to transparent and responsible AI require that users have a clear understanding of the capabilities, limitations, and functions of AI systems at the development, integration, and user levels. The selection of data, models, and algorithms for these systems define the quality, reliability, and accuracy of the generated output. In an effort to provide a level of transparency, OpenAI released details of the ChatGPT language model that provides a specification on the source and type of data and information utilized by this system (OpenAI, 2024b):

- *Publicly available on the internet*
- *License from third parties*
- *Our users or our human trainers provide*

The source and specifications for pre-training data and process have an impact on the performance of the model and suitability for certain requirements (Mandvikar, 2023). The selection of an open-source or proprietary LLM with understandable characteristics and alignment with the specific requirements, goals, accessibility, and process integrations are important considerations for the production of OER content.

Source Attribution

The specific sources of information utilized by deep-learning machine-learning methods used by GenAI to generate content are often indeterminable. The inability to identify individual and combined sources of the information used by these systems to generate OER content could introduce legal and societal issues related to integrity, credibility, validity, bias, and intellectual property. As an example, GenAI systems have recently demonstrated the ability to hallucinate which results in the fabrication of inaccurate information. An alternative option for source attribution in the development of OER material could include the independent identification of sources that validate auto-generated content.

Bias

The algorithms and data used for LLMs could contain potential biases specifically related to the selection criteria, incomplete, and mislabeled data. These conditions could introduce biased datasets and result in the reinforcement of bias in the generated data and OER materials. There is also the potential for human bias and assumptions in the development of AI systems. The common types of AI bias are published in IBM Think: Tech News, Education, and Events (Holdsworth, 2023):

- Algorithm
- Cognitive
- Measurement
- Out-group Homogeneity
- Prejudice
- Confirmation
- Exclusion
- Recall
- Sample/Selection
- Stereotyping

Despite the number of potential biases, there are proposed approaches that could limit or mitigate the impact on generated content. A proposed approach involves prohibiting the algorithm access to information that has a potential bias from the evaluation process. The intended result is to provide higher confidence in the information used to make important or impactful decisions (Uzzi, 2020). The decision to exclude specific data from the evaluation process must also be examined to determine any unintentional impacts. The potential for GenAI bias should be evaluated when considering GenAI-generated content referenced or incorporated in the production of OER material.

Privacy, Confidentiality, and Security

The foundational elements of data and information privacy require a clear understanding of the collection, storage, use, management, and dissemination of personal information. Personal data is utilized by GenAI developers and systems to improve performance, data monetization, and other purposes based on the specific business model. The authorized use and application of personal data by these services are defined in the terms and conditions, privacy policies, and other disclosures. These terms, conditions, and policies establish the conditions of user consent for the use, retention, and sharing of personal data. The majority of users may not review or understand the legal terms, conditions, or privacy impact prior to acceptance of the conditions of these agreements. The concerns over data privacy have resulted in increased data protection regulations and laws that provide users with an increased level of transparency and control over the business use of user-provided and system-collected data.

Confidentiality is another concern associated with the integration of GenAI with internet browsers, productivity software, and other applications. Online GenAI services require users to provide an e-mail address to create an account, which serves as a unique user identifier and potentially provides an indication of professional and organizational affiliation. The combination of this user-provided information with query submissions, history, and feedback may represent a concern for the confidentiality of user information. There are also potential concerns with the use of GenAI in the source code development process for commercial, research, and open-source software products. The source and quality of generated source code could result in vulnerabilities that impact the effectiveness of secure development processes and distribution of secure software applications that contain an increased number of vulnerabilities. The combination of the concerns related to privacy, confidentiality, and security should be considered when faculty, researchers, and

students register and submit data to these online systems and services for the development of OER content.

Restrictions and Regulations

There have been efforts to restrict or regulate the use and application of certain technologies including AI and GenAI. There are no identifiable restrictions or regulations that pertain to the use of these technologies for the development of OER materials other than intellectual property laws, regulations, and institutional restrictions. The focus on the role and use of GenAI in academic institutions has primarily involved the impact on student learning, instructional effectiveness, academic integrity, and ethical considerations. There have been restrictions adopted by grant sponsoring and extramural organizations that provide funding for research and scholarship that require the disclosure of any GenAI content used in the application, evaluation, or materials used for the determination or selection of funded awards. There are also policies and restrictions that relate to principles of security, privacy, confidentiality, and non-disclosure. Accordingly, it is important to determine if the institution, grant, or other funded initiative has policies or restrictions on the use of GenAI, GPT, LLM, or other AI technologies. These policies may include conditions for the inclusion of GenAI content in derivative public domain or OER materials. The National Science Foundation (NSF) encourages the disclosure of any use or application of GenAI technology in proposal submissions (National Science Foundation, 2023). The National Institutes of Health (NIH) has established prohibitions on the use of NLP, LLM, or GenAI technologies for the formulation and analysis of research and grant proposals and the peer review process (National Institutes of Health, 2023). The submission of research and grant proposals that include OER materials should be reviewed for any potential use of GenAI or other restricted technologies.

Accuracy

The validity of text and multimedia content creation is dependent on the model architecture, parameters, algorithms, sources, and the update interval of data. AI-generated content should be independently validated to ensure the accuracy of information prior to inclusion in OER material. The update interval of the LLM may impact the validity of the generated output based on the period of time since the model was updated. The current version of ChatGPT models has not been updated since September 2021 where the integration of LLMs and search engine augmentation could provide a method to refresh the models (Vu et al., 2023). It has also been difficult to generate repeatable results with GenAI systems which may introduce questions related to the validity and reliability of certain generated content.

Authorship and Intellectual Property

There has been considerable debate concerning complex intellectual property issues related to the ownership of the content created by GenAI and the data used to train LLMs. These issues are pertinent when considering the reuse, revision, remixing, retention, and redistribution aspects of OER. It has been historically acknowledged that computers and intelligent conversational systems are generally not recognized as creators or authors of intellectual property. Accordingly, there are legal questions pertaining to authorship and ownership associated with GenAI systems, processes, and data that include:

- *Original data, creative information, and creative works used in the model training process*
- *Developers of AI algorithms and technologies*
- *User-provided data for queries and feedback*
- *Generated Content*

A contributing factor to the success of OER has been the development of the Creative Commons (CC) License. This series of licenses provides individuals and institutions with a method to obtain advance permission for the specified use of a creative work from the author in accordance with the copyright law (Creative Commons, 2024). These licenses provide selectable options for the author that include attribution, identical redistribution, and prohibition for non-commercial use. In an effort to create an increased level of transparency in the use of GenAI, applications have been created that detect the use or inclusion of GenAI-generated content from Chat GPT, GPT 3, GPT 4, Bard, and LLaMa (GPTZero. 2024).

Policy Considerations

There are policy considerations and implications related to the use of AI systems. In relation to the specific issues related to the development and production of OER materials, the following considerations are proposed for faculty, researcher, and student contributors:

- *Disclosure of the type of GenAI and extent it was used in the development of OER materials*
- *Accountability for accuracy, validity, and attribution for the development of OER materials*
- *Consideration for potential instances or impact on bias, privacy, confidentiality, or security*
- *Assess potential risks associated with the use of GenAI for the production of OER material*
- *Determine the potential impact of combinational AI technologies*
- *Evaluation of referenced or incorporated OER material from other authors to determine if GenAI technologies may have been used in the production of the material*

An article in Harvard Business Review on the topic of government policy and regulation identified three obstacles to the regulation of GenAI, specifically related to the definition of harm, assessment of damage, and the regulation of speech (Burt, 2023). A proposal for the use of Constitutional AI to provide oversight of AI systems has been introduced by Anthropic. This proposed self-supervision approach establishes techniques that require one AI system to monitor the compliance of another AI system based on parameters that include safety, accuracy, integrity, and other human-based values to reduce the potential policy and societal impact associated with the deployment of unsupervised technologies (Anthropic, 2024).

Conclusion

AI and GenAI represent transformative and constantly evolving technologies. Conversational AI is expected to be integrated with approximately forty percent of enterprise applications in 2024 (Gartner, 2023). Accordingly, the capabilities, adoption, and application of these technologies must be continuously evaluated to determine the potential current and future capabilities, limitations, and applications associated with these technologies to generate OER and the associated considerations to limit the potential negative impact on individuals, institutions, and society.

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