Innovation and Overview of Technologies in the Open Educational Resources

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This paper presents the collaborative efforts of researchers and educators from Albania, Croatia, Slovenia, and North Macedonia in updating a tutorial for Open Educational Resources (OER) as part of the Integrating Digital Content and Digitalization of High Schools (iDADOHS) project. Brainstorming sessions generated 46 ideas for enhancing OER tutorials, which were prioritized based on their potential impact. The focus was on digital content creation, interactive tools like GeoGebra, PhET, Kahoot, and Padlet, and an OER repository. Selected ideas shaped a comprehensive tutorial on Google Sites, providing technical guidance and innovative methodologies for classroom use. Advanced analysis techniques, including Latent Dirichlet Allocation (LDA) and Non-negative Matrix Factorization (NMF), categorized suggestions, ensuring a structured integration of digital tools. This initiative advances digital literacy and educational quality through collaborative, technology-driven solutions.

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1 Collecting Innovative Ideas for the Development of OER Tutorial

There are many tutorials on the design of digital content within Open Educational Resources (OER) framework. However, because the technology is constantly changing, a constant "update" of the tutorials' is needed. To achieve this task a group of researchers and teachers from Albania, Croatia, Slovenia and The Republic of North Macedonia universities and high schools was formed in project called "Integrating Digital Content and Digitalization of High Schools" (iDADOHS). The project was conducted from 2021 to 2023. The consortium has prepared the tutorial adapted to the current trends in the technology. Based on our previously conducted analysis and recommendations, the needs of the teachers in high schools have been considered at the tutorial preparation. The tutorial consists of technical instructions for the design of Open Educational Resources and ideas for their use in the classroom by using modern technologies and methodologies. In the first phase, the innovative ideas regarding the development of the tutorial were gathered from the iDADOHS expert group. Later on, the gathered ideas were analysed, and the Tutorial was prepared on the Google Sites platform.

Figure 1: Brainstorming process of the iDADOHS consortium members on the topic of »OER Tutorial« at the University of Maribor, Faculty of Organizational Sciences

Source: Own

In the initial phase of the OER Tutorial development the members of the consortium participated at the providing the ideas on the topic: "Open Educational Resources Tutorial". There were 11 participants engaged at the idea generation process applying principles of brainstorming at the University of Maribor, Faculty of Organizational Sciences in Kranj, shown in Figure 1.

In the 30 min time, the 11 members of the consortium generated 46 ideas. These were later on evaluated according to the five-point scale where the criterium was the usefulness for the project tutorial implementation.

2 Results of Idea generation Session

Generated ideas according to rank with the sum of collected points on 5-point scale (Sum), average (Avg) and Standard Deviation (SD) are shown in Table 1. Here the first part, 23 out of 46 ideas are shown. As the most important topic the following idea emerged: "Courses (online) for teaching staff, how to create digital content". This is general goal of the project, however, the emphasis is on "digital content". The second in rank was "Geogebra https://www.geogebra.org/?lang=en, Phet animations and tools: (experiment, virtual lab, measurments) https://phet.colorado.edu/en/simulations/filter?type=html,prototype, Kahoot tests https://kahoot.com/ Padlet - collaboration: https://padlet.com/" providing the possibilities to use several packages at the development of content. Additional top ranked ideas were to use synthesiy.io tool as well as to provide the repository of OER material. The provided top ideas were used as the guideline in further development.

Table 2 shows the additional 23 generated ideas according to rank, i.e. from rank 24 to 46 with Sum of collected points on 5-point scale (Sum), average (Avg) and Standard Deviation (SD). Here one of the repeating ideas were to provide the feedback systems (Škraba et al., 2003) in order to improve learning and teaching experiences.

Table 1: First 23 generated ideas according to rank with Sum of collected points on 5-point scale (Sum), average (Avg) and Standard Deviation (SD)

Rank	Ideas - Open Educational Resources	Sum	Avg	SD
1	Courses (online) for teaching staf, how to create digital content	49	4.455	0.688
2	Geogebra https://www.geogebra.org/?lang=en, Phet animations and tools: (experiment, virtual lab, measurments) https://phet.colorado.edu/en/simulations/filter?type=html,prototype , Kahoot tests https://kahoot.com/ Padlet - colaboration: https://padlet.com/	46	4.182	0.982
3	Creating repository for OERs / diferent fields/subjects	45	4.091	0.944
4	Use www.synthesia.io to convert automatically lecture text to video	45	4.091	0.944
5	Many Short Videos vith external subtitles so video can be used in different languages	44	4.000	0.894
6	Digital library	44	4.000	0.775
7	Sharing best experiances of using OER	44	4.000	0.775
8	Re-use Respoitorium of OER - https://pitt.libguides.com/openeducation/biglist	44	4.000	1.095
9	creation of video digital materials for the realization of practical exercises in professional subjects	44	4.000	1.000
10	E lessons for school subjects	43	3.909	1.044
11	Study animation as at: https://www.3blue1brown.com/	43	3.909	1.044
12	WeBWorK https://webwork.maa.org/intro.html open-source online homework system for math and science courses.	43	3.909	0.831
13	Free tools for recording screen on computer/laptop	43	3.909	1.136
14	Creating e-learning system with OERs	42	3.818	0.982
15	Electronic lessons for tehnical subjects and practice in simulator/s	42	3.818	1.168
16	Creating videos and using Handbrake to convert the videos in any format (https://handbrake.fr/)	42	3.818	0.982
17	OBS Studio for Videos	41	3.727	1.272
18	OERs with different localizations	41	3.727	1.421
19	creation of a link of textbooks for professional subjects at the European level or members of this project with the possibility of access without restriction of contents.	41	3.727	1.104
20	creation of video materials for technical schools in terms of professional textbooks	40	3.636	0.809
21	Creating different Animations "www.OpenToonz.github.io/e/" to be used for lectures	40	3.636	1.206
22	Formation of a group for exchange of ideas and digital contents	40	3.636	0.809
23	Google Forms www.forms.google.com for Automated Knowledge testing - Quiz	40	3.636	0.924

Sorurce: Own

Gathered ideas from the expert group provides good overview of the OER technologies and concepts, that should be incorporated at the Tutorial design.

Table 2: Additional 23 generated ideas accoridng to rank, i.e. from rank 24 to 46 with Sum of collected points on 5-point scale (Sum), average (Avg) and Standard Deviation (SD)

Rank	Ideas - Open Educational Resources	Sum	Avg	SD
24	Creating exams with https://exam.net/	40	3.636	1.027
25	A handbooik of tecnical (digital) vocabulary in the target languages	40	3.636	0.924
26	Online workshops	40	3.636	1.433
27	Connection with github - webpage + code + yt video.	39	3.545	0.934
28	Hints/tips/troubleshooting working online	38	3.455	0.820
29	A short technical Slovenian/Macedonian/Croatian/Albanian dictionary	38	3.455	1.293
30	open source/free tools for making movies	38	3.455	1.440
31	System for performing quizzes for students.	38	3.455	0.934
32	Creating open source application which aggregates OERs from different sources	38	3.455	1.293
33	Movie maker	37	3.364	1.206
34	Using WIKIS www.m.mediawiki.org as collaboration document to write lecture content and later others extend and modify	37	3.364	0.924
35	Online exams, quizzes ...	36	3.273	1.104
36	Define the hardware for video web server - not to be hosted only on yt.	36	3.273	1.104
37	Include packages - javascript html https://h5p.org/	35	3.182	1.471
38	Develop the simple feedback system that can be used in the classroom	35	3.182	1.079
39	Creating new standard for distribution of OERs	35	3.182	1.328
40	Recording Online video guide	35	3.182	0.982
41	Online voting	34	3.091	1.044
42	Providing the OER material for the IoT based on esp32	34	3.091	0.944
43	Define the software / hardware stack for OER - which software packets would be most usefull.	34	3.091	1.044
44	Develop the system to comment videos like on yt.	34	3.091	1.136
45	Online self-assessment	32	2.909	0.831
46	Online feedback	31	2.818	0.874

Source: Own

The ideas proposed by the expert group on "Open Educational Resources" cover a wide range of tools and strategies for creating and sharing digital educational content. To define short, aggregated description were generated by OpenAI (OpenAI 2023). Result was list of 38 suggestions.

Overall, provided ideas from the expert group showcase various strategies and tools that can enhance the creation, distribution, and utilization of Open Educational Resources (OERs) in diverse educational contexts.

According to the provided ideas the following list of the technologies has been compiled which is shown in Table 3. The short description of the proposed technology is provided as well as the web link.

Table 3: The set of extracted technologies proposed by the expert group

Short description	Links
Interactive Simulations - Phet	https://phet.colorado.edu/en/
Online game-based learning - Kahoot	https://kahoot.com/
Collaborative Web Platform - Padlet	https://padlet.com/
AI Video creation tool - Synthesia	https://www.synthesia.io/
OER Resources	https://pitt.libguides.com/openeducation/find
Engine for precise programmatic animations - Manim / 3Blue1Brown	https://www.3blue1brown.com/ https://github.com/3b1b/manim
Online Homework System	https://webwork.maa.org/intro.html
Online Exams	https://exam.net/
Collaboration and Documentation Platform	https://www.mediawiki.org/wiki/MediaWiki
Content Collaboration Framework	https://h5p.org/
Video Sharing	https://www.youtube.com/ https://vimeo.com/
Public digital library of open educational resources	https://oercommons.org/
Interactive geometry, algebra, statistics and calculus toolset - GeoGebra	https://www.geogebra.org/

Source: Own

3 Methodology – Analysis of the Ideas Set

To categorize the generated ideas, we employed Latent Dirichlet Allocation (LDA) (Blei et al., 2001, 2003; Lavrič & Škraba 2023a, 2023b) and Non-negative Matrix Factorization (NMF) (Lee & Seung, 1999) methods, implemented using python libraries (Sievert et al., 2016; Mabey, 2021) and python (Portilla, 2023) respectively. The goal is to identify appropriate categories that will later be assigned suitable names by experts. The number of categories, which will be a user-defined input, has been set to seven (7).

For the analysis, we utilized Non-negative Matrix Factorization in conjunction with Term Frequency-Inverse Document Frequency (TF-IDF) algorithms. TF-IDF algorithms leverage word frequency to determine the relevance of words to specific categories. NMF is an unsupervised algorithm that enables dimensionality reduction and clustering. The document-term matrix (DTM), serving as the basis, was applied.

DTM is a matrix that describes the frequency of terms within individual generated ideas. Rows correspond to ideas, and columns correspond to terms.

The first step involved generating a vector space model for the ideas, including stopword filtering, resulting in the DTM matrix A. TF-IDF term weight normalization was performed on matrix A. Factors were initialized using non-negative double singular value decomposition (NNDSV). Projected gradient NMF was then applied to matrix A. The basis vectors provide the categories for the generated ideas, while the coefficient matrix offers the category membership weights for clustering the ideas.

Figure 2 presents a word cloud generated from the 46 ideas proposed by the expert group. The word cloud visually represents the most frequently occurring terms, with the size of each word indicating its relative prominence in the dataset.

A closer examination of the word cloud reveals key themes centered around "creating," "online," "videos," "system," and "OERs." These dominant terms suggest a strong emphasis on the development of digital educational content, particularly through online video creation and Open Educational Resources (OER). Additionally, words such as "digital," "hardware," "software," "professional," "subjects," "Geogebra," "quizzes," and "feedback" indicate a broader scope of ideas related to digital learning tools, multimedia integration, and interactive educational methods. Based on this analysis, the overarching focus of the expert group's ideas can be summarized as "Creation of Online Videos and OERs", highlighting the growing importance of video-based instructional materials and digital platforms in modern education.

In Figure 3, we can observe the visualization generated by pyLDAvis (Sievert et al., 2016; Mabey, 2021), which serves as a valuable tool for exploring and effectively categorizing ideas. When dealing with a substantial number of generated ideas, this task can prove to be challenging.

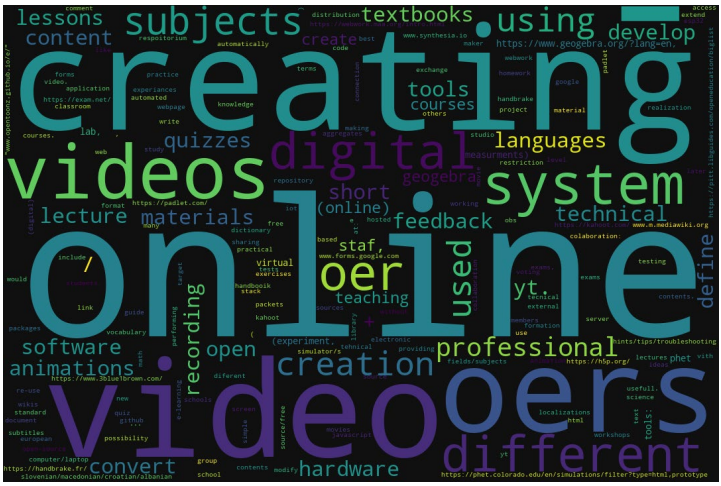

Figure 2: Word cloud for ideas generated by the expert group
Source: Own

On the right side of the figure 3, we can observe the word frequency within a specific category. In our case, this corresponds to category 1. Based on the word distribution, category 1 can be labelled as "videoLectureCreation."

The circles on the left side of the figure represent different categories, and the distance between them signifies the semantic relationship between these categories.

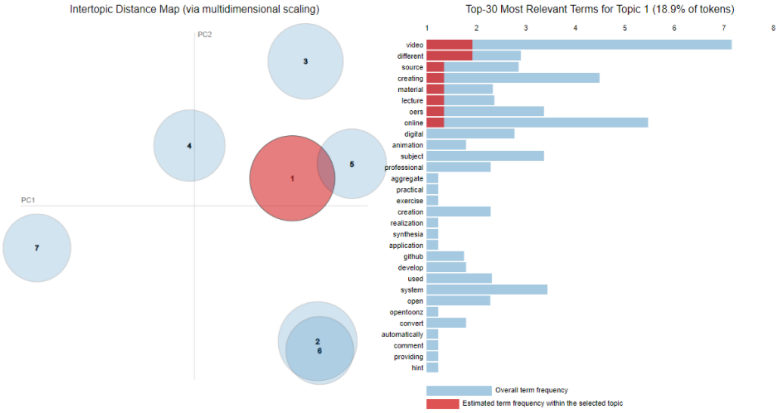

Figure 3: Categories associated with 46 ideas generated by expert group
Source: Own

The interactive nature of the pyLDAvis tool facilitates a deeper understanding of the interplay between categories and ideas.

Table 4 presents topics identified using Latent Dirichlet Allocation (LDA) and their corresponding short, aggregated descriptions. The analysis focused on extracting the most relevant terms associated with each topic to determine key themes.

Upon inspecting these topmost relevant terms across all categories, a recurring concept emerged: "Video-Creating-Online-System." This suggests a strong emphasis on video content creation and online systems as essential components in the development of Open Educational Resources (OER).

The expert group highlighted the significance of this finding, recognizing that video-based instructional materials—whether in the form of recorded lectures, interactive demonstrations, or software-assisted content creation—play a crucial role in modern OER production. Additionally, the presence of terms related to software, hardware, and online platforms further reinforces the growing reliance on digital tools for educational content development.

Table 4: Topics indicated by LDA and short, aggregated description

Topic #	Topmost relevant terms for particular topic	Description
1	Video, different, source, creating, material, lecture, OERs	Video lecture creation
2	http, video, using, geogebra	Geogebra online video
3	Video, software, online, define, hardware, OERs, creating	SW/HW for video creation
4	System, online, http, webwork	Online system
5	Video, subject	Video subject content
6	Textbook, creation, professional	Profession textbook creation
7	Form, tool, google, free, online, digital	Free online tools

Source: Own

By identifying these core themes, the analysis underscores the necessity of robust, accessible, and user-friendly online video creation systems to enhance the quality and accessibility of OER. This insight aligns with broader trends in digital education,

where multimedia resources are increasingly being integrated into teaching and learning frameworks.

4 Conclusion

In conclusion, the OER Tutorial was a collaborative effort by the iDADOHS expert group, aimed at providing technical instructions and ideas for effective OER use. Roles were assigned based on expertise in areas like virtual reality and gaming solutions. The tutorial development began with a brainstorming session, leading to the creation of online courses and a repository for OERs, among other ideas. Focusing on high school teachers and emerging technology trends, the tutorial emphasized digital content creation and interactive resources. By incorporating suggested ideas and leveraging various technologies, it aimed to empower educators and improve learning experiences. The tutorial stressed accessibility, multilingual support, and the reusability of OERs, while recognizing the value of practical exercises and online assessment tools.

Overall, the creation of the OER Tutorial showcased iDADOHS team's commitment to adapting to educational technology changes. By equipping teachers with skills and knowledge, the tutorial aimed to enhance education quality and promote OER usage. The collaborative effort and expertise of iDADOHS team members ensured a comprehensive resource for educators seeking guidance in OER implementation.

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End notes

This study presents the collaborative efforts of the iDADOHS consortium, comprising researchers and educators from Albania, Croatia, Slovenia, and North Macedonia, in developing an updated Open Educational Resources (OER) tutorial. Through brainstorming sessions, 46 ideas were generated, prioritized, and analyzed using Latent Dirichlet Allocation (LDA) and Non-negative Matrix Factorization (NMF). The final tutorial, hosted on Google Sites, provides technical guidance and methodologies for OER implementation, focusing on digital content creation and interactive learning

tools. The initiative underscores the importance of structured, technology-driven approaches in enhancing digital literacy and education quality.

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