

X Modal X Cultural X Lingual X Domain X Site Global OER Network

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ABBREVIATIONS

Acronyms	Definitions
OER	Open Educational Resource
API	Application Programming Interface
JSON	JavaScript Object Notation
URL	Uniform Resource Location



ABSTRACT

In this report we present various visual interfaces that have been developed within the project. Each interface employs one or more X5GON services and provides a different solution: from finding relevant OER materials based on the user query, to having a full-fledged learning environment where users can interact with the OER materials, as well as services that help people with disabilities (i.e. the visually impaired). All of these solutions can be found through a common interface called the X5GON Platform Overview, which also presents the technology developed and available as a result of the X5GON project.



1. INTRODUCTION

The purpose of this document is to report on the final version of the visual interface, including its exploratory interface for analysing the platform and user behaviour. While the previous deliverable 2.2 – Final server side platform, where we presented the platform architecture and how the components developed in different work packages are connected, was technical, this deliverable presents the different visual solutions and interfaces that include one or more functionalities of the X5GON platform services.

The X5GON platform collects metadata from OER materials found in different repositories, processes and enriches them with additional information, translates them, and makes them available to the various services:

- **Search engine.** Enabling finding relevant OER materials via a REST API based on the user query (more details available in deliverables 4.x);
- **Recommendation engine.** Provides recommendations based on the material the user is currently interested in (more details available in deliverables 4.x);
- **Learning analytics machine.** Gives an insight into the user's behaviour and their learning patterns, identifies the appropriate order of material consumption, etc. (more details available in deliverables 3.x);
- **Feed service.** Enabling access to the metadata acquired and enriched through the pre-processing step.

We have developed multiple interfaces that employ one or more of these services, and extends their functionalities.

The document is structured as follows. Section 2 describes the X5GON platform overview – the interface used for presenting the goals, tasks, and solutions developed within the project. It also serves as the access point to various other interfaces. Next, Section 3 describes the X5GON discovery – the interface for easily searching through the indexed OER materials. An extension of the previous interface, the X5Learn serves as a learning environment and is described in Section 4. The recommendation plugin – a simple solution for including a list of recommended OER materials into one's website – is described in Section 5 **Error! Reference source not found.** Afterwards, Section 6 describes the future work, and finally we conclude the document in Section 7.



2. X5GON PLATFORM OVERVIEW

The X5GON platform overview interface is designed to provide a thorough overview of the goals we want to achieve within the project, how we are going to achieve them, and what solutions were developed. In addition, the overview invites the OER repositories to join the X5GON Network. The interface is publicly available at <https://platform.x5gon.org/>.

2.1. HOMEPAGE

The homepage of the X5GON platform provides a brief but insightful overview about the different aspects of the X5GON platform. It starts with a short but thorough description of the platform (see Figure 1), followed by the overall architecture decisions and advantages of the platform.

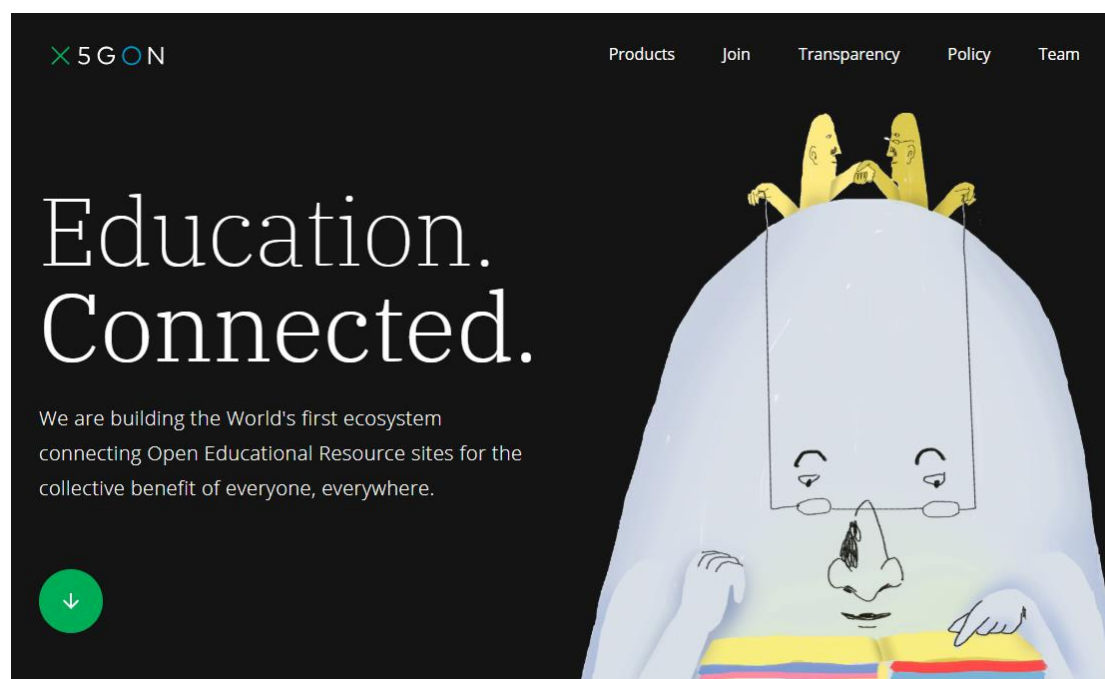


Figure 1. The X5GON Platform Overview homepage. It provides a brief but insightful overview of the goals, ecosystem, and products of the X5GON Platform.

Afterwards, a description of the beneficiaries of the X5GON ecosystem is provided. These include the learners (accessing to the open educational resources that can be used to gain a particular skill or knowledge), teachers (finding relevant educational resources for use in their classroom), institutions (providing insight into the use of their educational resources, as well as how they are consumed), researchers (giving access to a rich dataset which can be used to train machine learning models in the field of education), and governments (having an overview of the use and creation of educational resources funded by the government). This is followed by the products, described in Section 2.2, the X5GON Global Network, found in Section **Error! Reference source not found.**

2.2. PRODUCTS

The platform also serves as an entry point to the different products developed within the X5GON project. In this section, we present a brief overview of the different products developed within the X5GON platform.



2.2.1. Recommend

The recommend product provides a way of showing the content of ones OER repository in the network of other sites¹. It allows placing recommendation modules into OER repositories, and with it enable the repository user to access all of the OER materials processed and indexed by the X5GON Platform. While all of the functionalities of this product are available via a public API, it also provides an easy way of embedding recommendation lists into the websites (as described in Section 5).

2.2.2. Analytics

The X5GON analytics is developed to understand the trends of the content usage as well as other learning analytics aspects developed within work package 3 of the project. A visual interface is still in development, but will employ machine learning models found in the Learning Analytics Machine (LAM) described in deliverables 3.x.

2.2.3. Discovery

The discovery product allows the user to search through the indexed OER materials². A detailed description of the discovery tool is found in Section 3.

2.2.4. Translate

The X5GON translate page describes the capabilities of the translations and transcription models. It gives an overview of the supported languages (German, Spanish, French, Italian, Slovenian, English, Catalan, and Portuguese) for both the translation and transcription of videos, audio and text. The results of these models are comparable with Google Translate. More on the transcription and translation models can be found in deliverable 3.5 – Final support for cross-lingual OER.

2.2.5. Connect

The X5GON connect service allows the users of OER repositories to be connected to the X5GON ecosystem within the Moodle LMS as well as a regular website. On this page, we present the main concepts of the X5GON connect service: (1) the X5GON token, and (2) the X5GON connect API.

The X5GON token is a value used by the X5GON Platform to disambiguate between different OER providers. When a provider joins the X5GON global network (see Section 2.4) they receive a unique token which is then used to connect their repository to the X5GON Platform via the connect API.

The X5GON connect API is designed to collect anonymized user activity information from the registered OER repositories. The page provides a full description of the technical side of connecting the OER repository to the X5GON platform, as well as the security aspects and tools required to notify the user about data sharing. In addition, the page also contains detailed instructions of how to connect a Moodle LMS to the X5GON platform.

2.2.6. Feed

The feed product is the X5GON API documentation³. With it, a user can access the X5GON platform REST API and programmatically access the X5GON products and services. With the documentation, we wish to encourage both the OER and the

¹ <https://platform.x5gon.org/products/recommend>

² <https://platform.x5gon.org/products/discovery>

³ <https://platform.x5gon.org/products/feed>



research communities to access both the services and the materials in the X5GON platform, and to develop new and improve existing solutions that would help improve the education experience.

2.3. POLICY

The X5GON Platform is also designed to provide information about recent events that happen in the open education world - one of which is the acceptance of the UNESCO Recommendation in OER.

As part of this, it provides a short but thorough description of the different aspects of the accepted documents; ranging from the definitions and scope of OER, the aims and objectives to be completed – building capacity of stakeholders to create, access, use, adapt and redistribute OER; developing supportive policy; encouraging inclusive and equitable quality OER; nurturing the creation of sustainability models for OER; and facilitating international cooperation, as well as monitoring different aspects of OER.

2.4. X5GON GLOBAL NETWORK

In order to provide a tight collaboration with the OER community and their repositories we invite them to be part of the X5GON OER Network – and with it make the most out of the services and products provided by the X5GON platform. To this end, we developed a page describing what X5GON can offer, how can the OER repository contribute, and what X5GON promises to do with the provided content. In addition, we designed an application form which connects the OER repository to the network. Figure 2 shows the design of the application form.

Application Form

Fill this form to register your OER repository and get resources used to connect to the X5GON OER network. Once connected, we will identify the resources you provide and include them into our recommendations making it visible within the OER network.

Repository Information

OER Repository Name

Enter repository name

Name of the repository (ex. X5GON Platform)

Repository Domain

Enter repository domain

Domain where the repository resides (ex. platform.x5gon.org)

Maintainer Information

Maintainer Contact

Enter email

Person responsible for snippet integration at your institution

I'm not a robot

reCAPTCHA

Already a member of the OER Network? Login

Submit Form

Figure 2. The X5GON OER Network application form.

Once the provider registers to the X5GON OER Network, they receive a unique token which can be used in other products (such as the X5GON Connect Service). In the future, we will also enable the OER repository to upload their OER materials to the X5GON platform index using their unique token.

2.5. TRANSPARENCY

Due to the recent concerns about the transparency of artificial intelligence and machine learning models, we added a separate page regarding transparency which describes: (1) the implications of machine learning algorithms, (2) who is the data controller and



processor of the open educational resources (definitions in the context of the GDPR law), and (3) the copyrights clearance and management. Each section on this page has been thoroughly researched by the consortium, and validated by the lawyers working with the project members. This page is intended to provide an overview of how the X5GON platform handles the required legal aspects – from data processing to data ownership.

In short, the X5GON platform overview visual interface provides all of the information required by a new user to get familiar with the artificial intelligence solutions, legal side of data processing and sharing, as well as how to collaborate with the X5GON platform maintainers.



3. X5GON DISCOVERY

The X5GON Discovery is a search service where one can find OER materials that the user is interested in. It is designed for both students and teachers to find materials that would improve their learning experience. The X5GON Discovery is publicly accessible at <https://discovery.x5gon.org/>.

3.1. X5GON SERVICES

The X5GON Discovery interface employs the use of the X5GON search engine (described in detail in deliverable 4.6 – Final prototype of cross-language recommendation engine).

3.2. DESIGN

Figure 3 shows the entry point to the X5GON Discovery interface. It has a simple design with a single search bar and a number of suggested queries. Currently, the suggested queries are static, but will be changed in the future to reflect the interests of the user accessing the interface. In addition, the interface was designed to support computer screens, as well as tablets and search on mobile phones.



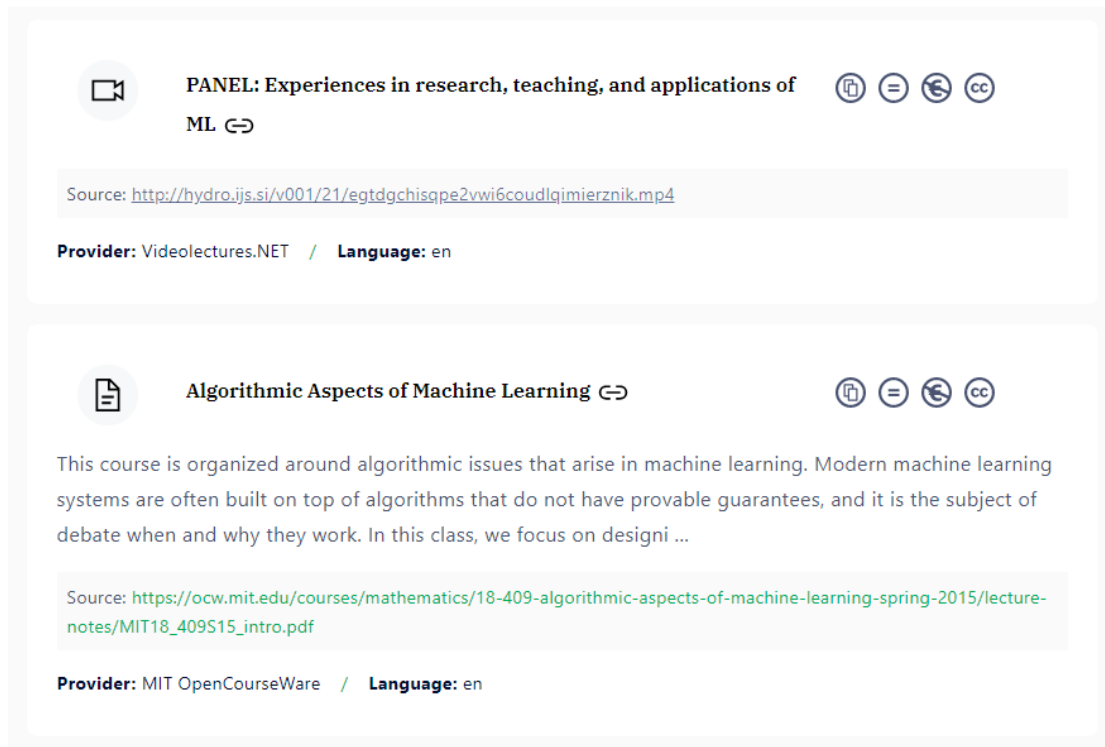
Figure 3. The X5GON Discovery entry point. It contains a simple search bar as well as some suggested queries.

Once the user inserts their query, they get a list of relevant OER materials. The information that is present are the following:

- **Title.** The title of the OER material.
- **Description.** The description of the OER material.
- **Type.** The type of the OER material. Options are: video, audio, and text.
- **License.** The license of the OER material. The materials that are under one of the creative commons licenses⁴ have a visualization corresponding to the license.
- **Source.** The URL to the actual OER material.
- **Website.** The URL to the website that provides the OER material.
- **Provider.** The provider of the OER material.
- **Language.** The language of the OER material.

⁴ <https://creativecommons.org/licenses/>

Once the user clicks on the OER material it will be redirected to the corresponding website that contains the OER material or to the material file. Figure 4 shows an example of the relevant OER materials shown for the query text “Machine Learning”.



The screenshot displays two search results for the query "Machine Learning".

Result 1:

- Icon:** Video camera icon.
- Title:** PANEL: Experiences in research, teaching, and applications of ML ↔
- Source:** <http://hydro.ijs.si/v001/21/egtdgchisqpe2vwi6coudlgimierzniak.mp4>
- Provider:** Videolectures.NET / **Language:** en
- Licenses:** CC BY, CC BY-SA, CC BY-ND, CC BY-NC

Result 2:

- Icon:** Document icon.
- Title:** Algorithmic Aspects of Machine Learning ↔
- Description:** This course is organized around algorithmic issues that arise in machine learning. Modern machine learning systems are often built on top of algorithms that do not have provable guarantees, and it is the subject of debate when and why they work. In this class, we focus on designi ...
- Source:** https://ocw.mit.edu/courses/mathematics/18-409-algorithmic-aspects-of-machine-learning-spring-2015/lecture-notes/MIT18_409S15_intro.pdf
- Provider:** MIT OpenCourseWare / **Language:** en
- Licenses:** CC BY, CC BY-SA, CC BY-ND, CC BY-NC

Figure 4. The X5GON Discovery search results for the terms “Machine Learning”. It shows the main information about the OER material, such as the material's type, source link, license, provider and language.

Future Work. The X5GON Discovery will also support filtering the results based on the following attributes:

- **Type.** The user can filter through the different types of materials inside the Search Index. Options: video, audio, and text.
- **Licenses.** The Discovery tool supports searching through all of the Creative Commons licenses (CC BY, CC BY-SA, CC BY-ND, CC BY-NC, CC BY-NC-SA, CC BY-NC-ND).
- **Languages.** Specifying the original language will filter to return only the OER materials with the specified original or translated languages.

Figure 5 shows the prototype interface being developed for filtering the OER material results. This will enable the users to find materials that fit their specific needs – based on the material type, license and language.

In addition, we intend to provide an “about” page which will describe all of the functionalities and options on the X5GON discovery page, as well as the “provider” page showing all of the OER repositories that are included in the search index. As part of the provider page, we will include an additional filter – provider filter – which will return OER materials that are located in the selected provider repository.

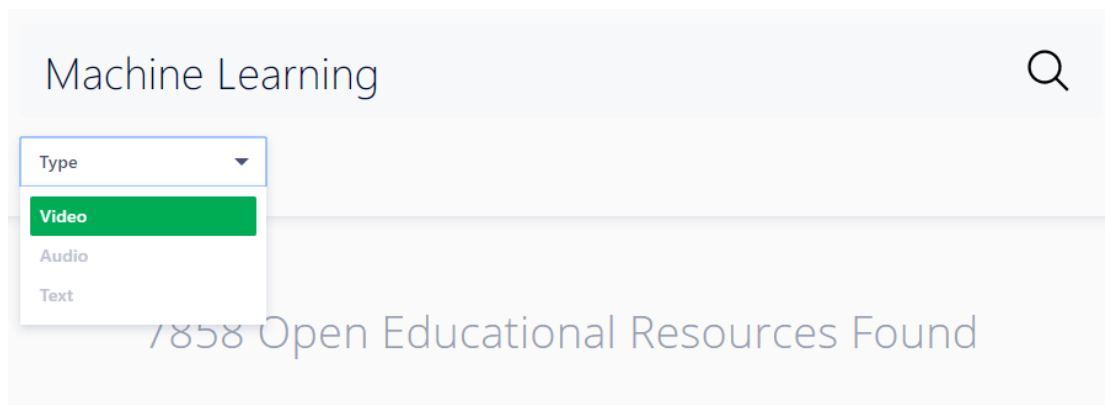


Figure 5. Prototype of attribute filtering in Discovery X5GON. It shows the dropdown for filtering through the material types. In the future, other filtering options will be supported.

3.3. DUCKDUCKGO'S X5GON DISCOVERY BANG

To increase the accessibility of OER materials to the users, we have requested DuckDuckGo⁵ - a search engine that is setting new standards of trust online – to add a new “bang” shortcut to their infrastructure.

DuckDuckGo bangs⁶ are shortcuts that quickly take the user to the search results on another site. In our case, we have requested to add the “x5” bang which will allow the user to make a search request on the X5GON Discovery service through the DuckDuckGo search engine. Once the bang is accepted, the user could start their DuckDuckGo query with the “!x5” statement and will redirect the query to the X5GON Discovery service. Figure 6 shows an example of a query using the “!x5” bang on the DuckDuckGo search engine.

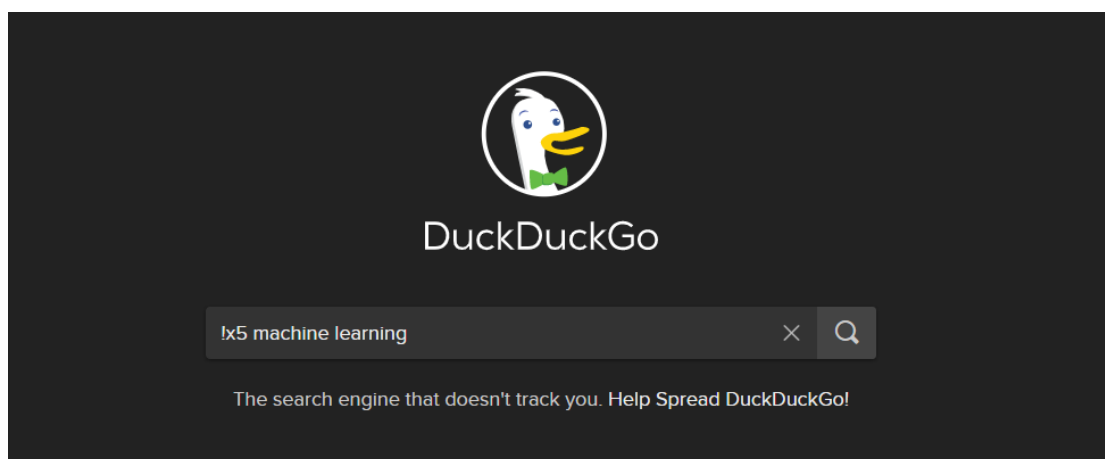


Figure 6. An example of the “x5” bang usage on DuckDuckGo. The user will be redirected to the X5GON Discovery service and will show the search results for the query “machine learning”.

⁵ <https://duckduckgo.com/>

⁶ <https://duckduckgo.com/bang>



4. X5LEARN

This section introduces the learner facing visual interface that integrates the AI components of X5GON to provide an effective, enjoyable learning experience to lifelong learners. X5Learn dashboard is available to the general public via <http://x5learn.org>.

4.1. X5GON SERVICES

X5Learn dashboard uses a wide range of services developed by the X5GON project. The services consumed by the X5Learn dashboard are as follows:

Recommend. X5Learn dashboard consumes the item-based recommendation service provided via the X5GON API. For item personalisation, it uses the TrueLearn algorithm [1] developed through the X5GON project. For more information about the item-based recommendation and TrueLearn, please refer to Deliverable 4.4 and 1.3 respectively.

Analytics. X5Learn incorporates the OER sequence prediction algorithm related to learning analytics. Once a learner selects a bundle of OERs, sequence predictor can be used to reorder the bundle in a sensible sequence for consumption. Please refer to deliverable 3.3 for more details.

Discovery. X5Learn leverages OER discovery by providing a search functionality. This is supported by accessing the search API from X5GON to present relevant OERs for individual search queries of the learners. For more details, please refer to Deliverable 2.2.

Translate. X5Learn is equipped with a fully functional video player that will also enable playing transcriptions and translations where they are available for the video resources delivered via the X5GON platform. For more information about transcription and translation services, please refer to Deliverable 5.1 and 5.2.

Feed. The X5GON feed API is used to harvest meta-data about OERs so that learners can be well informed about the sources of resources, descriptions etc. For more details, please refer to Deliverable 2.2.

4.2. DESIGN

The visual design of the X5Learn dashboard touches on multiple facets of presenting the right information to the learner. One of the major challenges undertaken by X5Learn in-terms of pushing the limits of interaction design is to design state-of-the-art User Interaction components to navigate information in long document types such as videos and pdfs. For a detailed description of this work, we refer the reader to deliverable 6.2.

The overall UI layout of the X5Learn learning platform is outlined in Figure 7.



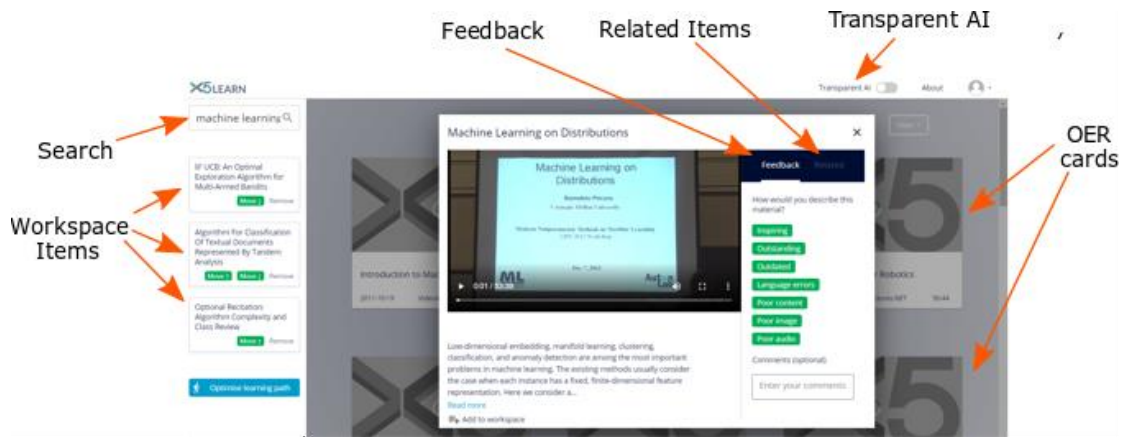


Figure 7. The overall UI layout of the X5Learn learning platform. The platform contains different components that help the user to consume and understand the learning resources.

In the following sections, we briefly describe the different aspects of the visual interface of X5Learn.

4.2.1. Searching for relevant OERs

X5Learn provides a search bar for the learners to search for relevant OERs that are useful to them. The search functionality is provided by the X5GON discovery service. An example of the search bar and retrieved OER is presented in Figure 8.

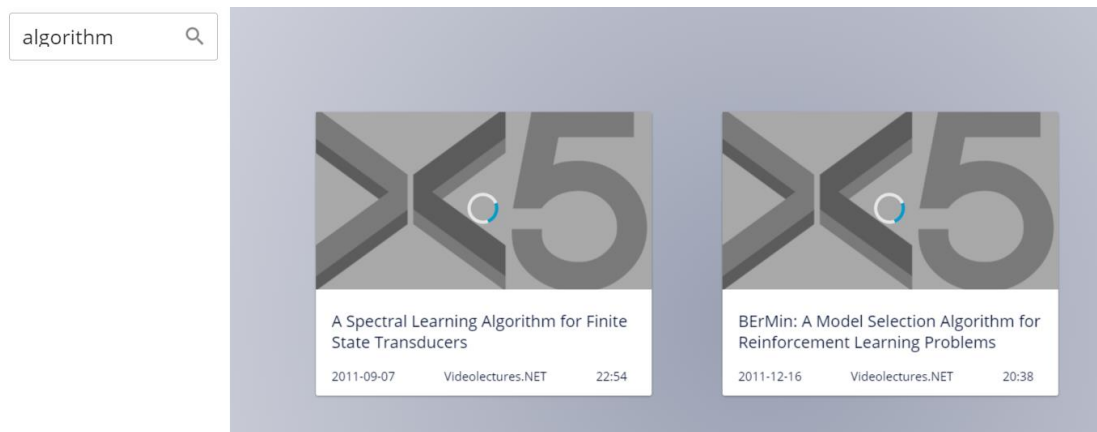


Figure 8. The search bar and an example of relevant OERs. The example shows the layout of OERs associated with the query "algorithm".

4.2.2. OER representation and Content Flow Bar

One of the most complex challenges about presenting OERs is to provide the learner with content representations that will enable them to navigate through the OER easily before choosing which OER they would like to learn with. This challenge is addressed by X5Learn in two layers; (1) *OER level*, and (2) *Fragments Bar* or fragment level.

OER Level. At OER level, X5Learn provides four distinct representations for the learners to understand the contents in a full OER, all of them presented in Figure 9.

1. **Thumbnails.** The conventional representation where a snapshot of the OER is shown. This method specially works for videos.
2. **Topic Names.** The most frequent topics in the OER are listed so that the learner can infer the main topics discussed in the resource.

3. **Bubbles.** The most frequent topics are represented. More semantically related topics are clustered closer together.
4. **Swim-lanes.** The most frequent topics are represented. The position in the OER where the topic word is mentioned is annotated using orange dots in the respective swim-lane.

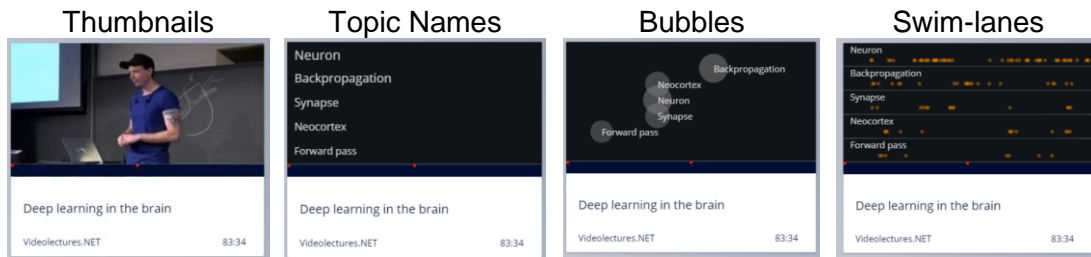
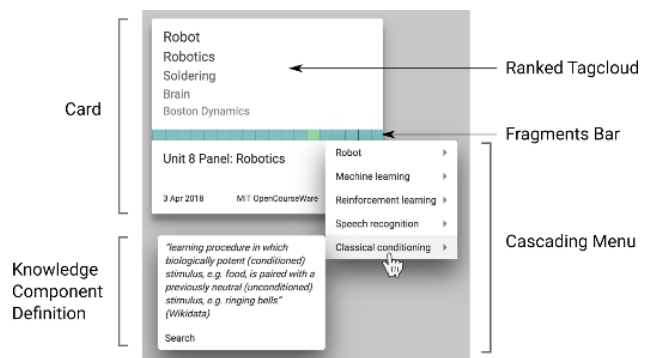


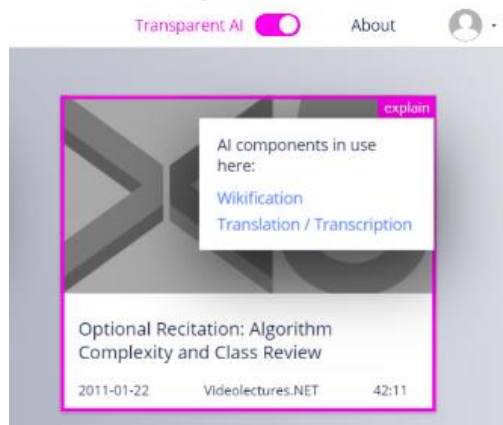
Figure 9. The four distinct representations of the OER level. For left to right, it shows the four distinct OER content representations: thumbnails, topic names, bubbles, and swim-lanes.

Fragments Bar (Fragment level). The Fragments Bar user interface [2] aims to augment and extend how users can engage with detailed content recommendations. The OERs are initially partitioned into *engageable fragments* as the first step and then enriched with topics. A primary goal is to make the results transparent, informative, specific and time saving.

To make the UI intuitive to use, X5Learn design leverages familiar patterns and techniques, such as cards, popups, and cascading menus. In addition, we introduce two novel elements, a *Topic Names Card* and *Fragments Bar*, in order to enable the learner to quickly preview Knowledge Components (topics) in an OER, as illustrated on the right.

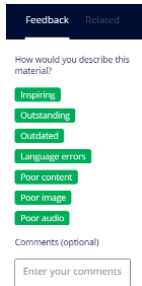


4.2.3. Transparent AI



Transparency is very important to X5Learn. A toggle switch on the top right side of the dashboard is provided for the learner to explore what AI technologies are used in providing them a friendly learning environment. Once it is switched on, the areas in the dashboard that use AI are highlighted with an “explain” button on the top right. The button contains a dropdown menu that lists the different AI technologies used with clickable hyperlinks to a dedicated page that explains the respective AI technology.

4.2.4. Feedback and related items



The side panel of the video/pdf viewing provides two tabs. The “Feedback” tab allows the user to provide feedback on the OER. The user can provide one of the default feedbacks or a custom feedback. User feedback is private and only viewed by its author. It provides the learner a channel to communicate with the X5Learn platform. The “Related” tab queries other OERs that are related to the currently viewed OER. This method uses content-based recommendation provided by the X5GON platform.

4.2.5. X5Learn Workspace

X5Learn also provides the capability for the learner to add their preferred OER materials to a “Workspace”. This workspace is persistent and provides context to the learner. Additionally, X5Learn uses the OER sequence prediction by X5GON Learning Analytics to reorder the materials in the learner workspace.



5. X5GON RECOMMENDATION PLUGIN

The recommendation plugin is designed to provide an easy approach of integrating the X5GON recommendation engine functionalities on other OER repositories. The plugin has already been described in deliverable 4.3 – Early prototype of recommendation engine, and deliverable 4.5 – Prototype of cross-site recommendation engine, but it is included to this report to provide a full list of visual components developed within the project.

The motivation for such a plugin is the following: if multiple OER repositories would include the recommendation plugin into their website, the user could navigate from one OER material to another – where the materials are similar to each other and not necessarily provided on the same OER repository. With this, we could connect different OER repositories, affording their users a larger number of materials to choose from.

5.1. X5GON SERVICES

The plugin employs the recommendation engine’s functionalities (described in deliverable 4.5 – prototype of cross-site recommendation engine) to retrieve the materials that are recommended to the user. These recommendations are based on the current OER material that the user has accessed.

5.2. DESIGN

The recommendation plugin is designed to be simple and easy to integrate to the OER repository. The plugin can be added using the HTML *iframe* element.⁷ Using this element, one can embed another HTML page into the current one. In this case, the OER repository can embed the recommendation list that is available via the X5GON platform into the website.

The REST API for generating the recommendation list retrieves the following query parameters:

- **Text.** The query text used to generate OER material recommendations.
- **URL.** The query URL. It must be associated with a material indexed by the X5GON platform. If no such URL is found, it uses the text query parameter, if present.
- **Width.** The embedded container’s width. Default value is 280 pixels.
- **Height.** The embedded container’s maximum height. Default value is 400 pixels.

Figure 10 shows an example of embedding the recommendation list using the *iframe* element. The highlighted parts represent the query parameters that can be changed, based on the material the user is currently viewing. Note that the URL query parameter is omitted from the example. The full documentation of the plugin REST API is available on the X5GON platform.⁸

⁷ <https://developer.mozilla.org/en-US/docs/Web/HTML/Element/iframe>

⁸ <https://platform.x5gon.org/products/feed>



```
<iframe
  src="https://platform.x5gon.org/embed/recommendations?text=machine%20learning&width=100%25&height=400px"
  style="border:0px;width:100%;height:425px"
></iframe>
```

Figure 10. An example of an iframe element used to embed the recommended list. In the example, we wish to embed recommendations for the given query text “machine learning”, but also wish to have the list to cover the whole width of the provided website space, but limit the height to 400 pixels.

Once the iframe is included into the OER repository, it shows the recommendation list where each material is presented by the following information:

- **Material Title.** The title of the material in its original language.
- **Material Type.** The material type as an image. Options: video, audio or text.
- **Material Provider.** The provider name of the OER material.
- **Material Language.** The original language of the material.

Figure 11 shows an example of the rendered recommendation list on one of the materials available on Videolectures.NET. It shows materials that are in different formats (video and text) as well as provided by different OER providers.

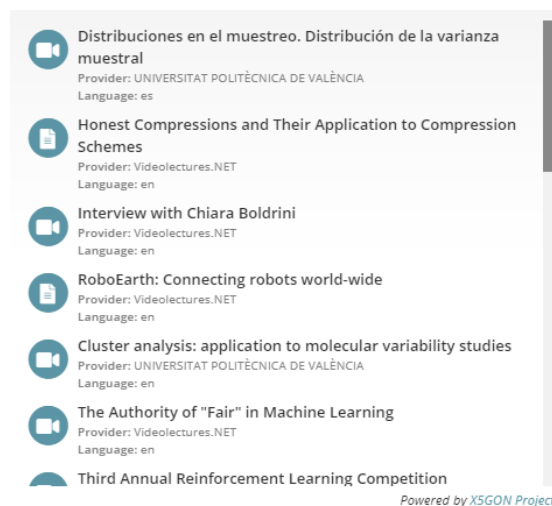


Figure 11. An example of the recommendation plugin. It shows the recommended materials based on the material titled "Deep Reinforcement Learning", available on the Videolectures.NET repository.⁹

⁹ Material available at: http://videolectures.net/rldm2015_silver_reinforcement_learning/

6. FUTURE WORK

In the future, we will extend and improve the services and interfaces that are already developed. As part of this effort, we have contacted a variety of different OER communities, to whom we presented our solutions and asked for feedback. The initial response of all of the communities was positive and they are interested in collaborating and developing new solutions to improve the accessibility of OER materials as well as providing better learning experiences to all.

In addition, we submitted a proposal to the 2020 Creative Commons Summit where we intend to present our solutions and get feedback from the OER community about the positive and negative aspects of our models, as well as think of other solutions that can be useful in the open education world.

The interfaces will also be tested in a variety of experiments both of individual components such as the fragments bar as well as by providing the frame for testing integrated X5GON components in the 'in the wild' studies.



7. CONCLUSION

In this document, we presented the different visual interfaces developed on-top of the services developed within the X5GON project. The **X5GON Platform Overview** interface serves as an introductory page of the services and products. It provides the both technical and political descriptions of the services, gives an overview of the products available, and invites the OER repositories to be part of the X5GON OER Network. The **X5GON Discovery** interface provides an easy way of searching through the OER materials that were processed and indexed by the platform. In addition, it provides filtering by license, material type, and material languages. The **X5Learn** interface is an extension of X5GON Discovery and serves as a learning environment. It aggregates all of the developed X5GON services and includes a feature called transparent AI – showing which parts of artificial intelligence are used and in which components of X5Learn. Finally, the **X5GON Recommendation plugin** provides an easy way of including OER material recommendations into different OER repositories.

The services and interfaces have been presented to a variety of different OER communities and will continue to collaborate with them. In the future, we hope to improve our services as well as visual interfaces to better fit the needs of different educational groups – from learners and teachers, to researchers, institutions and governments.



REFERENCES

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