



Gamification platform and back-end tools

SuperCyberKids Deliverable no. 5.1

Call: ERASMUS-EDU-2022-PI-FORWARD
Type of Action: ERASMUS-LS
Project No. 101087250



**Co-funded by
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Project ref. number	101087250
Project title	SCK - SuperCyberKids
Document title	Gamification platform and back-end tools
Document Type	Accompanying document to the platform software
Document version	v2, 28 October 2024
Previous version(s)	
Planned date of delivery	31 October 2024
Language	English
Dissemination level	Public
Number of pages	28
Partner responsible	GRIFO
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Abstract	This is the accompanying document of D5.1, the gamified platform (software) that describes the technical functionalities implemented, the user interface, how the platform works, and the APIs used as middleware between the platform and the external resources.
Keywords	gamification, platform, cybersecurity education
DOI	https://doi.org/10.17471/54030
How to cite	Memeo, R., Convertino, C., Pigliaru, P., (2024). Gamification platform and back-end tools. Deliverable 5.1 - SuperCyberKids project (ERASMUS-EDU-2022-PI-FORWARD - ERASMUS-LS - Project No. 101087250). DOI: https://doi.org/10.17471/54030

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1 Introduction

This document accompanies the release of Deliverable 5.1 “Characterization of gamified platform and back-end tools”, which is a specific instance (characterization) designed for the SuperCyberKids (SCK) project of GRIFO’s proprietary web-based gamification platform.

D5.1 is a piece of software. In this accompanying document we will provide an overview of the platform, give details about the technology behind it, describe the sections in which it is structured, the functions it provides and how the user experience unfolds through them. We will then give a list of the APIs used as middleware between the platform and the external resources. Thus, other replicated instances of the same framework can be set up by interested stakeholders (e.g., educational bodies, associations, schools) as part of the mainstreaming strategy after the end of the project.

The SuperCyberKids platform is available online at the address: <https://platform.supercyberkids.eu>.

2 Technical Description of the SuperCyberKids platform

2.1 General Description of the Platform and Features

The SuperCyberKids educational platform is built on an architecture based on WordPress, an open-source framework developed in PHP. This platform manages educational content structured in learning paths, with optional gamification elements. The main features include the management of learning paths, the ability for users to upload educational items or links to external resources, and the option to define and assign points and badges for user progression.

The learning path is displayed in a dashboard in the form of an interactive map developed with the Javascript library LeafletJS. Through gamification, the platform rewards users for completing educational modules, improving engagement by accumulating points and badges.

Additionally, an advanced AI-based search engine facilitates the navigation of educational content, leveraging semantic search, with data stored in a vector database.

The search, based on users' keywords, allows the identification of educational domains associated with competencies and learning outcomes entered into the platform. These competencies are linked to training modules and items suggested by users.

2.2 Technical Architecture of the Platform

The solution's architecture is orchestrated with Docker. The online structure includes the following containers:

1. Nginx: Used as the main web server to handle incoming requests and serve the platform's static content, configured to forward requests to the PHP container.
2. PHP with the WordPress open-source framework: Hosts the WordPress application with a dedicated PHP environment for managing content and learning paths, with OPcache enabled.
3. Python: A dedicated container runs the Python application that exposes APIs for managing AI searches and populating the FAISS vector database, stored locally.

The solution is connected to an external MySQL database server that manages WordPress tables and all platform data (modules, competencies, users, uploaded items, etc.).

Communication between the various services is handled via network links within the Docker orchestrator, facilitating the application's modularity and portability across different environments.

2.3 AI Search Implementation and WordPress Integration

The AI search plugin uses a JavaScript-based user interface (`g4s_ais_tools.js`) to handle AJAX requests. The requests are managed by WordPress through a custom endpoint that calls the Python function for content analysis and indexing.

The `app.py` file, executed in the `python_api` container, uses the OpenAI API to generate semantic embeddings and stores them in the FAISS vector database, enabling semantic similarity-based searches.

The Python function retrieves the relevant competencies and returns them as JSON output, which is then used by WordPress to populate the list of competencies associated with the educational module.

2.4 Functionality of Python Embedding and Search

The Python code includes functions dedicated to embedding generation and semantic similarity search. An embedding is a numerical representation of data that allows complex objects (such as words, phrases, images, or other data) to be mapped into a multidimensional vector space. In the context of machine learning and AI, embeddings are used to transform unstructured data into vectors that retain relevant information about the original data.

For example, in Natural Language Processing (NLP), word embeddings (such as those generated by models like Word2Vec or OpenAI) represent each word as a vector in a space where the distance between vectors reflects the semantic similarity between the words. This allows for mathematical operations on words, such as searching for similar words or analyzing context.

These functions use a framework to connect to an external model such as the one provided by OpenAI, or locally installed models, to generate the embeddings and store them in the locally installed FAISS vector database designed to manage and search large amounts of vector data efficiently.

Embedding Generation

The embedding generation function represents the first step in content indexing, specifically the descriptions of competencies and learning outcomes. When a new competency item is created or updated on the platform, the descriptive text is sent to the Python function, which uses the OpenAI API to generate a semantic embedding, which is then stored in the vector database.

FAISS Search Functionality

The FAISS search engine allows for large-scale semantic queries. When a user submits a query, the system:

1. Generates an embedding for the user's query using the OpenAI API.
2. Performs a similarity search with FAISS, returning a list of competencies ranked by relevance.
3. Once the competencies are retrieved, utilities fetch the associated educational modules or items.

2.5 List of the APIs used as middleware between the platform and the external resources

GRIFO has also implemented the communication via simple API interfaces between the back-end of the gamification platform and possible external learning resources, such as, for example, other games besides Spoofy and Nabbovaldo which are already part of the SuperCyberKids ecosystem. These REST APIs are designed to monitor and track interaction with external resources from the learning and gamification platform.

The APIs accept and return data in JSON format, ensuring interoperability and integration with external systems, providing a simple and scalable interface for integrating external resource monitoring and tracking functionalities.

2.5.1 Base URL

The base URL for accessing our APIs is currently provisional on the development platform:

<https://platform.supercyberkids.eu/v1>

2.5.2 Start or Continue a Game Session

Endpoint

POST /games/session

Description

This API tracks the start of a new game session for a specific game. The game must provide a unique gameCode that represents the game and will be communicated by the platform managers, a UUID generated by the game representing a game session, and the language selected by the user. It should be called at the start of a new game session or when resuming a saved game.

Request

STRING – gameCode, Game code.

STRING – UUID, Unique identifier of the user.

STRING – language, Language selected by the player.

Request example (JSON)

```
{
  "gameCode": "nabboblackmail",
  "uuid": "550e8400-e29b-41d4-a716-446655440000",
  "language": "it"
}
```

Answer

- **200 OK:** ok.
- **400 Bad Request:** invalid data sent.
- **404 Not Found:** resource not found.
- **422 Unprocessable Entity:** processing exception.

2.5.3 Track the Duration of a Game Session

Endpoint

POST /games/session

Description

This API is designed to be called at specific intervals and is used to roughly track the duration of a game session. It checks the active status of a client in an existing game. You need to provide the UUID of the session generated at the start and the game code.

Request

STRING – gameCode, Game code.

STRING – UUID, Unique identifier of the session.

Request example (JSON)

```
{  
  "gameCode": "nabboblackmail",  
  "uuid": "550e8400-e29b-41d4-a716-446655440000"  
}
```

Answer

- **200 OK:** ok.
- **400 Bad Request:** invalid data sent.
- **404 Not Found:** resource not found.
- **422 Unprocessable Entity:** processing exception.

2.5.4 Submit the answer selected by a user for a question

Endpoint

POST /games/questionAnswer

Description

If the game includes questionnaires or quizzes, this API enables to track the question and the answer selected by the user. It should be called when the user selects an answer. The following elements are

needed: numeric question index, the question text (preferably in English even if the user views the question in a different language), the numeric answer index, the answer text (preferably in English even if the user views it in a different language), the question topic, the session UUID generated when the game started, and the game code.

Request

INT - `questionIndex`, Question index.

STRING – `questionText`, Question text.

INT – `answerIndex`, Answer index.

STRING – `answerText`, Answer text

BOOL – `isCorrect`, True or false

STRING – `topic`, Question topic.

STRING – `gameCode`, Game code.

STRING – `UUID`, Unique identifier of the session

Request example (JSON)

```
{
  "questionIndex": 1,
  "questionText": "Who was the first president of the United States?",
  "answerIndex": 2,
  "answerText": "George Washington",
  "isCorrect": true,
  "topic": "USA story",
  "gameCode": "nabboblackmail",
  "uuid": "550e8400-e29b-41d4-a716-446655440000"
}
```

Answer

- **200 OK:** ok.
- **400 Bad Request:** invalid data sent.
- **404 Not Found:** resource not found.
- **422 Unprocessable Entity:** processing exception.

2.5.5 Authentication

To access these APIs, a Bearer authentication token is required. This token must be included in the request header as follows:

Authorization: Bearer <your-token>

3 Target users of the platform

In order to protect children’s privacy and avoid use and storage of any sensitive data related to them, **the SCK platform is designed to be used by *adults***, i.e. School Heads, Teachers and Parents. Children aged from 8 to 13 are indeed the final target users of this ecosystem on cybersecurity, but their access to the platform must take place always under the supervision of the teacher in the classroom, or parents at home, and using the login details of a registered adult.

Access to the platform is free but registration is required. In order for the platform to function, and to enable sending automated emails with login details and password retrieval instructions, it is necessary that users give a functioning email address in the registration phase.

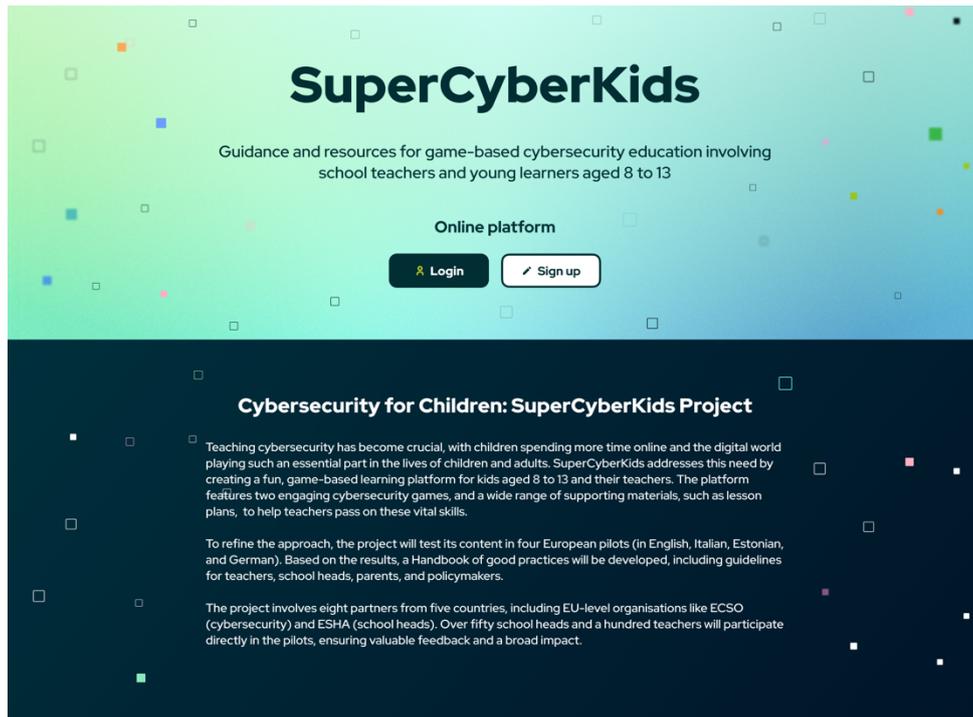
4 Presentation of the platform user interface

4.1 Landing page

In this page users will find very general information about the SuperCyberKids project and the platform.

The LOGIN button allows registered users to enter the platform.

The SIGN UP button allows new users to register.



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Project number: xxx-x-xxxx-xxxx-xx-xxxxxxxx

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Follow the SuperCyberKids project:

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[Privacy policy](#)

Figure 1: SCK platform Landing page

4.2 Accessing the platform: Registration and Login

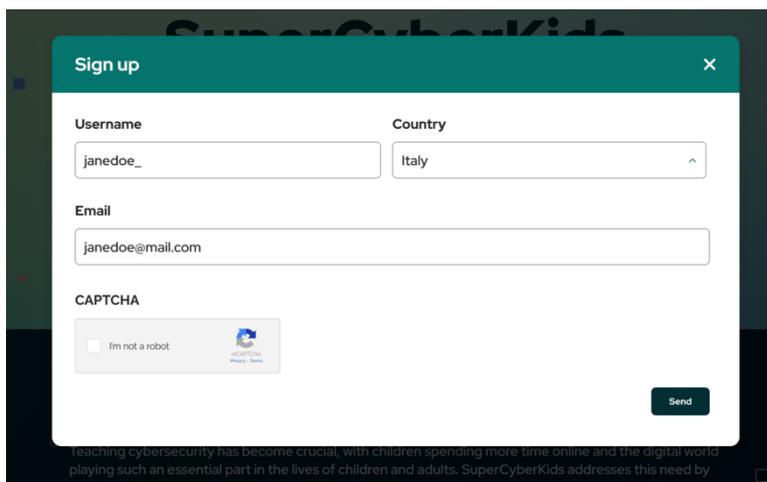


Figure 2: Registration form

To sign up for the platform, it is necessary to select a username and email, and the country of provenance. After filling in the Registration form, the system sends an automated email to the registered address with login details (Username and Password). Users can change their password upon first login from the User profile page (see section 4.8 below).

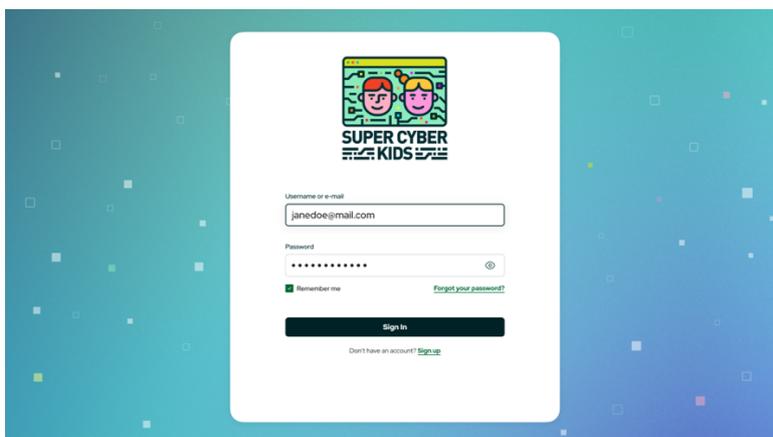


Figure 3: Login form

4.3 Homepage with map of the SCK modules

This page is viewed when users enter the platform. It contains the **map of the 18 modules that have been prepared and approved by the SCK project**. They make up the SCK education eco-system on cybersecurity. Through a set of buttons and menus, this page gives also access to all the functionalities of the platform.

The map of the modules has been designed to look like a computer motherboard. It is divided into three areas, each of different colour:

- Technical Skill (green)
- Social Skills (blue)

- Integrated Skills (red).

The colour of the three areas grows lighter when nearing the outermost part of the circle; in the centre the colour is deeper, indicating that those modules are at the core of the SCK recommended curriculum, as explained in R3.1.1 “Guidelines for schools (head teachers and teachers) - initial version”.



Figure 4: Home page or map of SCK approved modules

The top menu contains the following buttons:

- **SCK items:** this button provides access to this page, where users can select one of the 18 modules available. By clicking on this button on the top menu in other pages of the platform the users go back to this page.
- **Community items:** this button provides access to resources suggested by users to be used by the SCK community at large (see section 4.4 below).
- **My Playlists:** access to a selection of specific resources by the user currently logged in to the platform.

- **Profile:** access to the Profile page with information about the user currently logged in (see section 4.8 below).

Buttons provided in the top menu enable to change the language of the user interface (English, Italian and Estonian), to access the Tutorial (see section 4.9) and the notifications sent by the platform administrators.

At the top right-hand corner there are two buttons:

- Search
- Knowledge test

That give access respectively to the Search function (see section 4.5) and to the Knowledge test for assessing initial or final knowledge (see section 4.7).

4.4 Community items

This page can be accessed by clicking on the “Community items” button on the top of the navigation page. This area of the platform is a common repository of all resources suggested by users (teachers). It contains all the items suggested (i.e. links to games or web pages), uploaded (i.e. videos or documents) and catalogued by users, and is visible to all users registered in the platform.

PLEASE NOTE: all items shown in this mock-up are fictitious, they DO NOT refer to real items and are shown only for demonstration purposes.

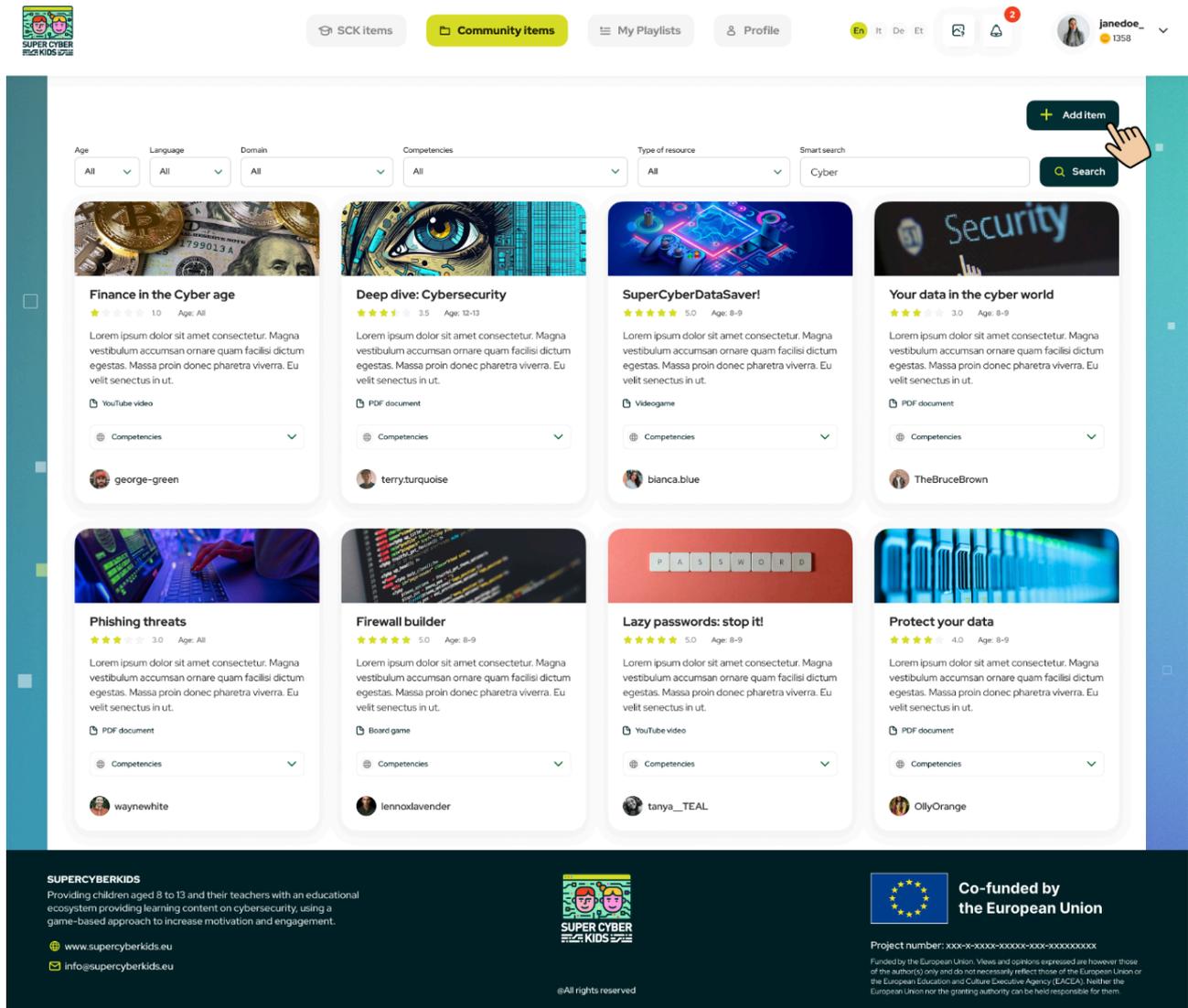


Figure 5: Community items desktop

The items are shown as cards. Each card contains a short descriptive text, and the list of competencies associated to that item (viewed by clicking on the drop-down menu Competencies). At the bottom there is also the username of the user who suggested or uploaded that learning resource.

The cards for Community items also contain an indication of the type of resources (i.e., videogame, PDF document, YouTube video, lesson plan). The stars shown on the card are connected to the rating system: an average of the stars given by users to this resource is shown, 1 star being the lowest appreciation and 5 stars the highest.

By clicking on the card, users can launch the related item (open a lesson plan or a document, launch a video, play a game if embedded in the platform), or select it to be added to their personal playlist (see section 4.4.2 below).

4.4.1 Add an item to the Community items repository

To add a new learning resource or item to the repository (“Community items”), users can click on the button ADD ITEM in the top right-hand corner (see figure 6 above). A window pops up with several fields where users can select all the appropriate metadata to associate to the item they are suggesting for inclusion in the SuperCyberKids Community items repository. The fields are the following:

- Title* (open field)
- Description (open field)
- Age*
- Language*
- Competency Domain and related competencies*
- Item type* [Game, Lesson plan, Video, Document]
- Lesson Style [game-based learning, traditional classroom, other]
- Intended Learning Outcomes (open field, only for lesson plans)
- Image associated to that item.

Fields and menus indicated with * are mandatory.

The example in figure 7 below shows the process of adding a PDF document associated to the Domain “Malicious Code” and to specific competencies.

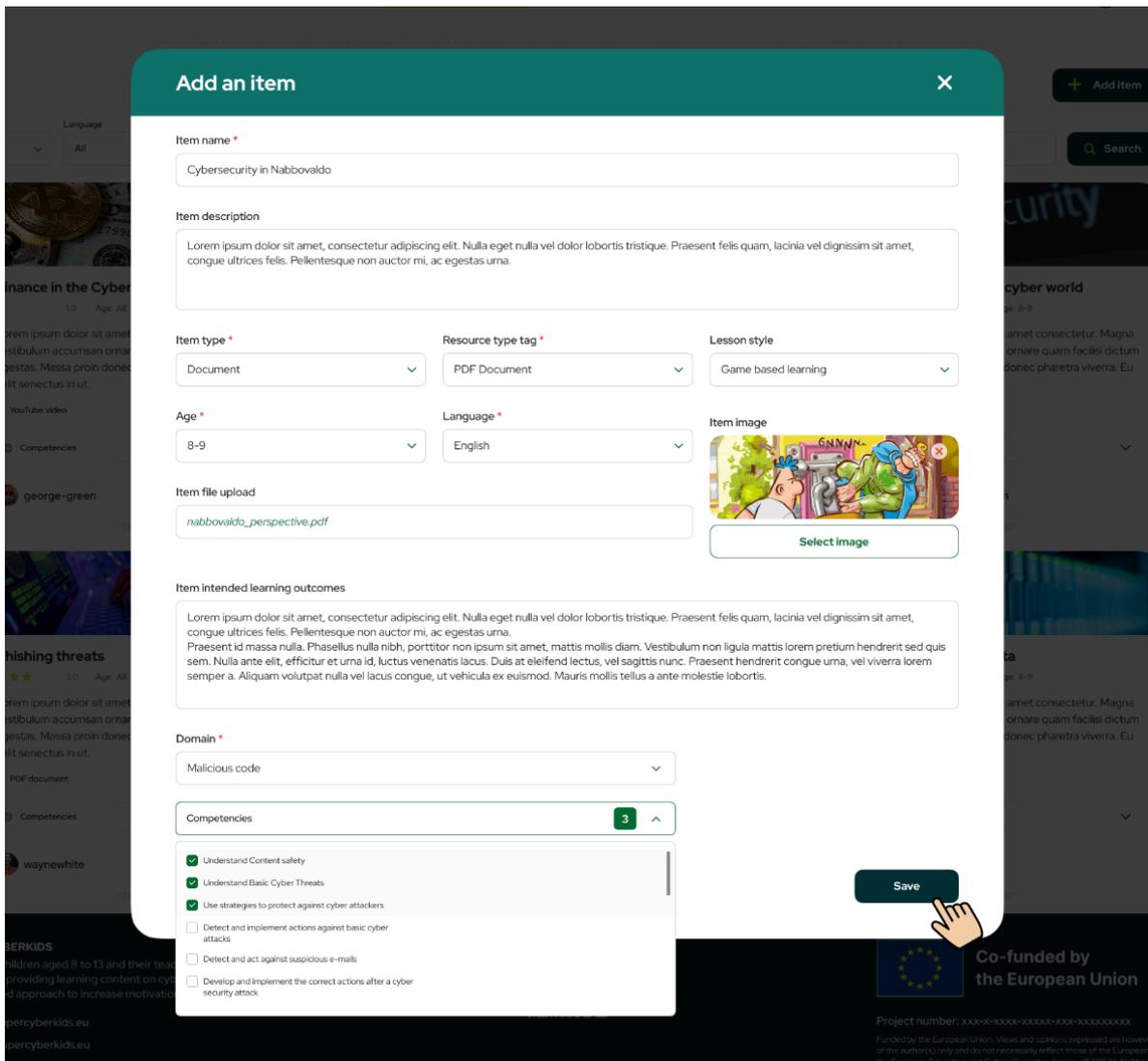


Figure 6: Add an item to the common repository

4.4.2 Add an item to a personal playlist

After a user has suggested or uploaded an item with all the appropriate metadata, he/she can select that item to create their own playlist. The personal playlist can contain both items suggested by the user who is creating the playlist, and/or items suggested by other users that are available in the Community items area of the platform. Users must first click on the card describing the item and then click on the button “Add to playlist”.

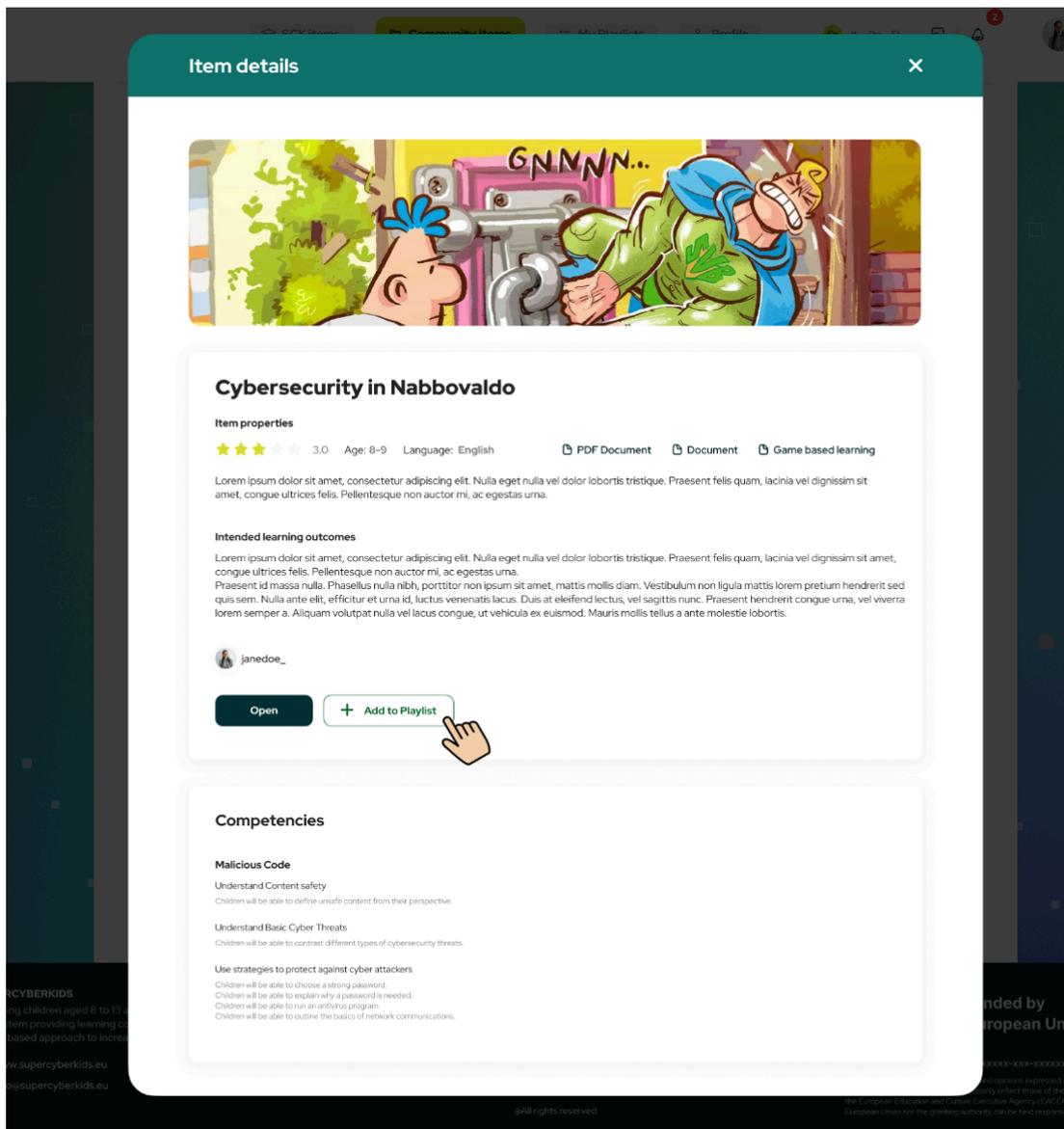


Figure 7: add an item to the playlist

A window will open showing the available playlists created by the user currently logged in. He/she can select one of the already existing playlists or create a new one.

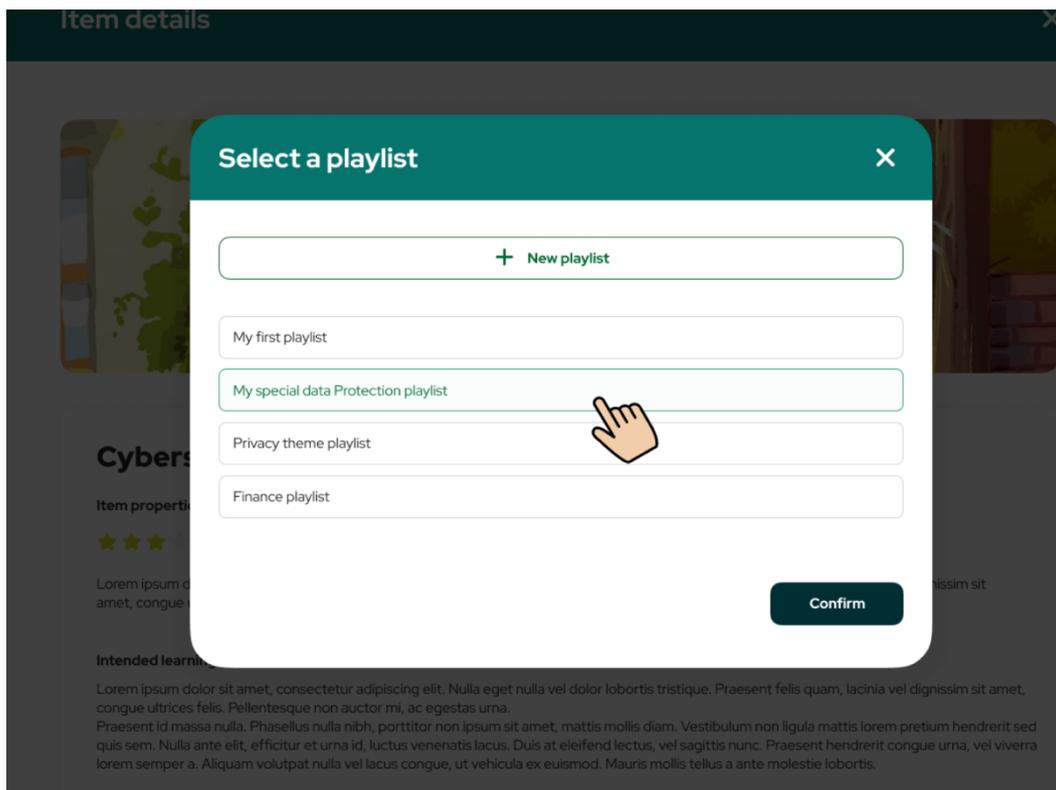


Figure 8: Add an item to Playlist

4.5 Search function

The Search function can be used to retrieve learning resources in both areas of the platform, the SCK approved modules and the Community items suggested by users. After clicking on the button RESOURCE SEARCH in the home page (see figure 5), users can access the Search page (see figure 9), where they can type one or more keywords, and use search criteria by selecting options from five drop-down menus:

- Age
- Language
- Domain (referring to the six domains of cybersecurity identified in the project, *Malicious Code, Frauds, Preventing Technologies, Abusive Content, Data Privacy & Data Awareness, and Safety*)
- Competencies [please note that when a domain is selected, the drop-down menu Competencies shows only the competencies pertaining to that domain]
- Type of resource [possible options: lesson plan, game, document, video].

The figure below shows the result of a search with the keyword “Cyber”.

PLEASE NOTE: all items shown in this mock-up are fictitious, they DO NOT refer to real items, and are shown only for demonstration purposes.

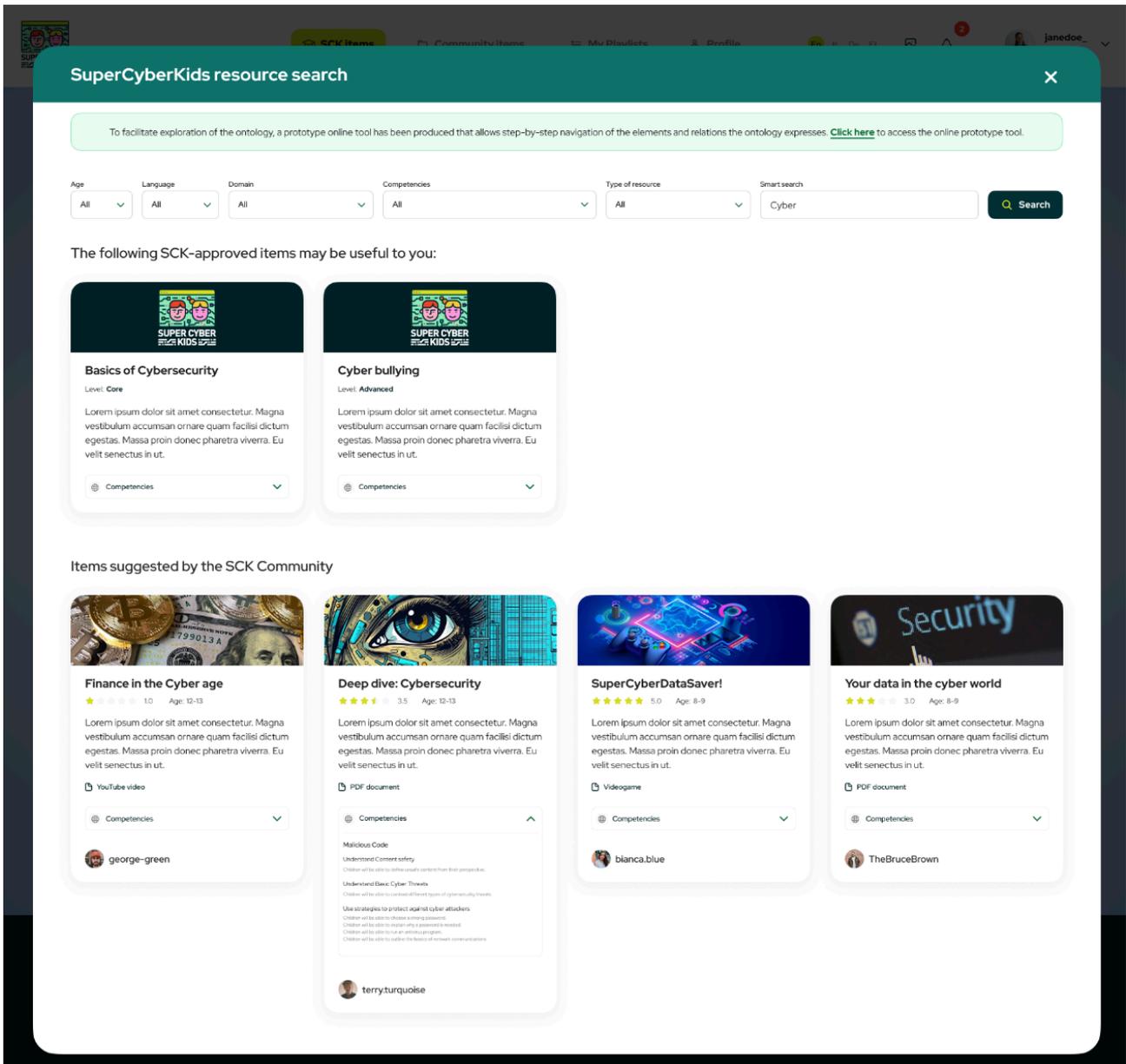


Figure 9: Search page with results

The page that shows the results of the Search is divided into two areas:

- the top area shows the items matching the search retrieved in the ***SCK approved items*** area of the platform, that contains the 18 modules set up by the SCK project;
- the bottom area shows the items matching the search retrieved in the ***Community items*** area of the platform, a common repository of all resources suggested by users.

Results are shown in form of card. Each card refers to an item, and contains a short descriptive text, and the list of competencies associated to that item (see in the example above: item “Deep dive: Cybersecurity”). At the bottom of the card there is also the username of the user who suggested or uploaded that learning resource.

The cards related to Community items also contain an indication of the type of resources (game, PDF document, YouTube video).

Below there is an example of a specific search using the fields provided: age: 10-14, domain “Malicious Code”. The user can select the competencies related to that domain in the drop-down menu by checking the boxes.

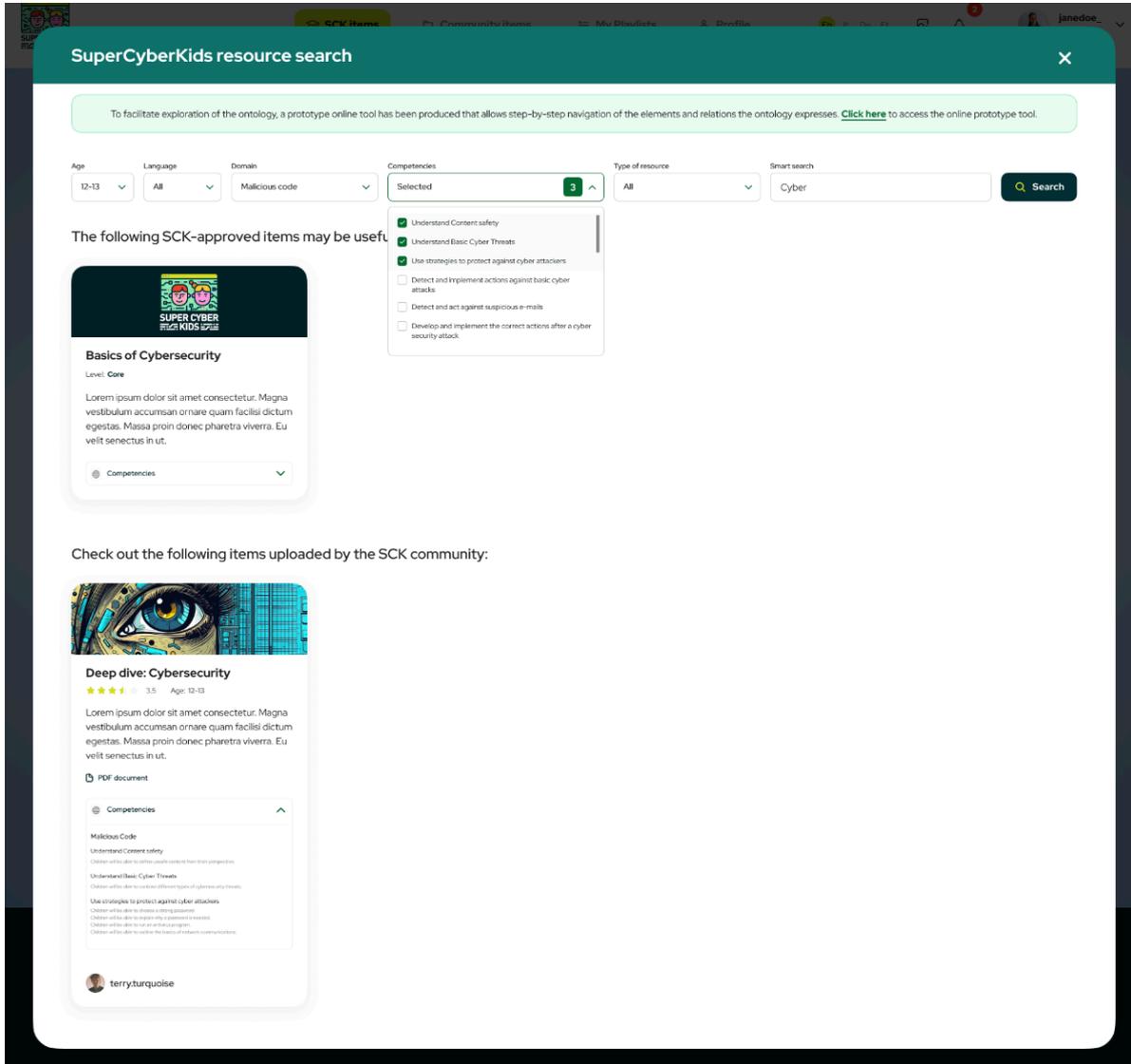


Figure 10: search using specific competencies

At the top of the page (green background), there is a link to the Ontology Domain Explorer tool developed by CNR as additional (external) tool to explore the ontology.

4.6 Launching a module

This figure shows what happens when a user clicks on one of the 18 modules in the navigation page (see section 4.4 above). All modules are open, i.e. there is no fixed sequence to follow. In the example shown, the user has selected the module “Firewalls and browsers”.

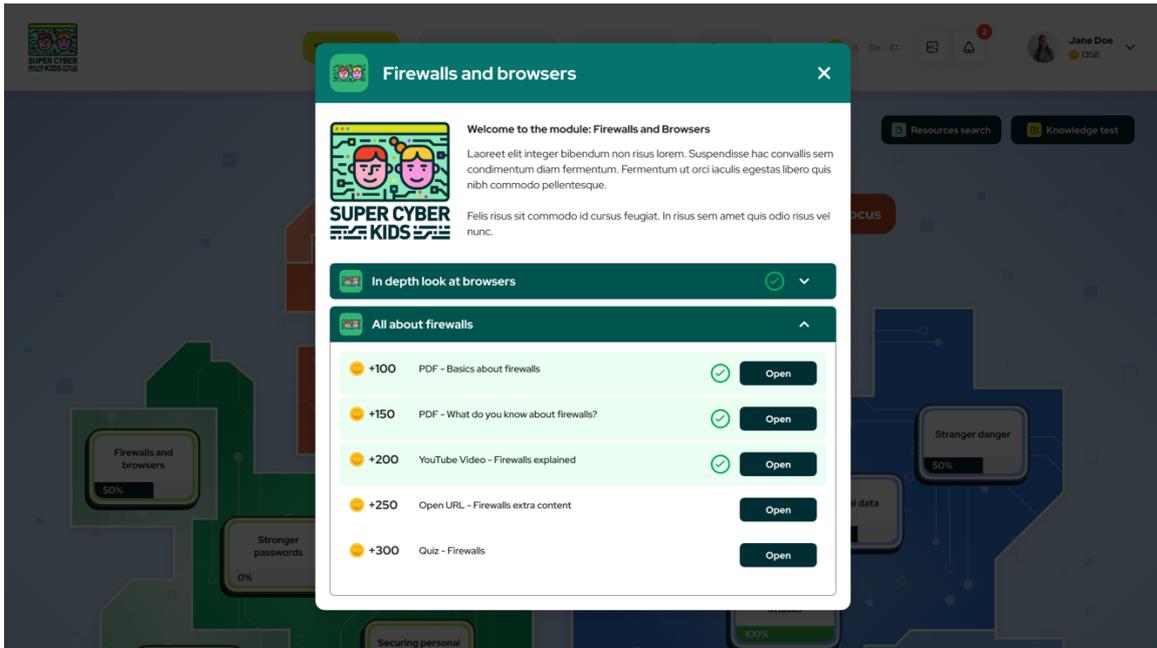


Figure 11: Opening a module

The window contains a list of all the items that make up the module: they can be a lesson plan, a document to download, a quiz to test the knowledge, or ***a link to a game*** [see section 5 “Launching games from the platform” below]. Opening each item the user gains points that make up the final score.

When all the items in the module have been opened, and, in case of a quiz, the quiz has been passed, the user is shown this window with the final score for that module.

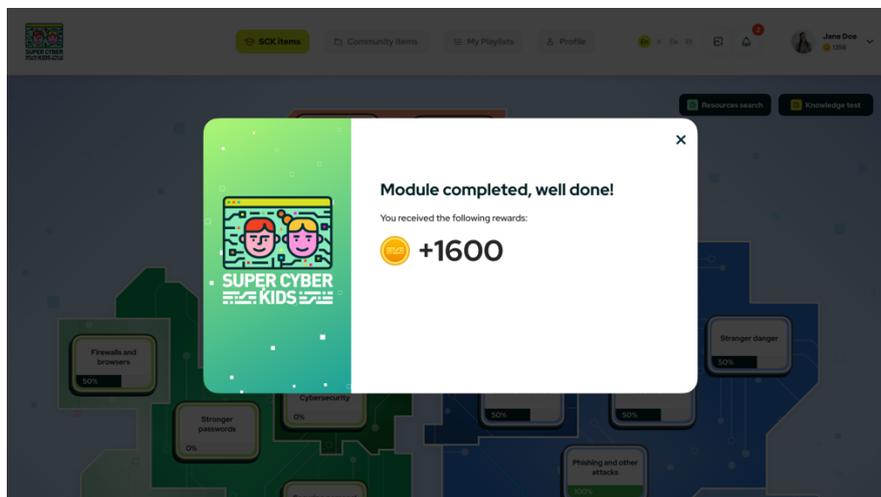


Figure 12: module completed

4.7 Knowledge tests

The Knowledge test can be accessed by the button at the top right-hand corner of the Home page (see section 4.4). It contains the initial and final assessments divided into the six domains of cybersecurity: *Malicious Code, Frauds, Preventing Technologies, Abusive Content, Data Privacy & Data Awareness, and Safety*. Users can select the domain and start answering the test.

It is designed to be used by teachers in classroom, asking questions to their pupils to test their knowledge of the topics in each domain. See Report 5.1.1 “Implementation of the tools for measurement and assessment of educational intervention” developed by UMA.

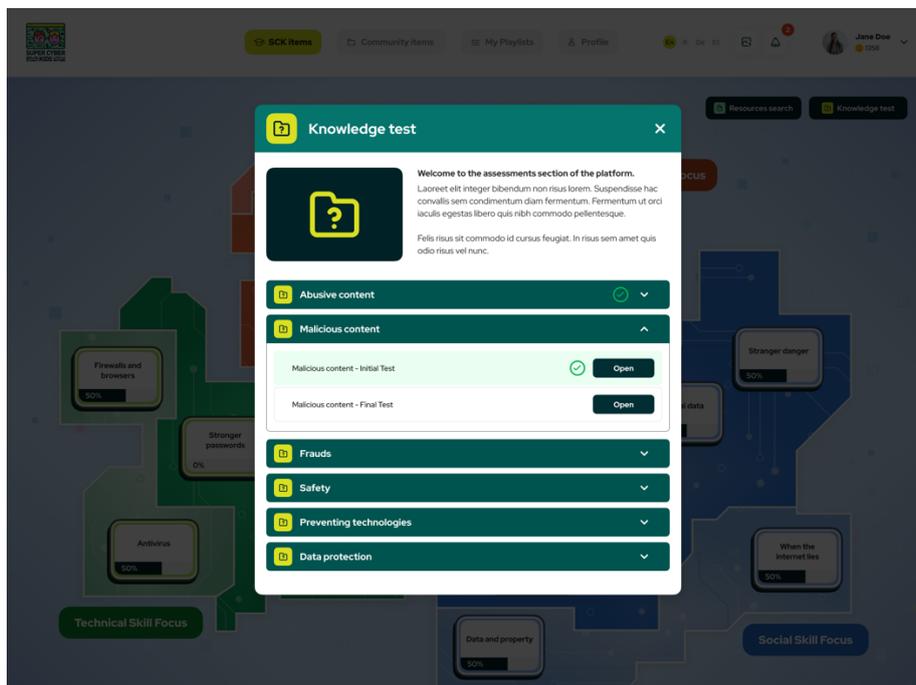


Figure 13: Knowledge test

Once the user has selected the domain that he/she wants to test the knowledge of the classroom about, they are shown two buttons: Initial test and Final test. The Final test can be opened only after the Initial test has been completed.

Both tests can be repeated as many times as wished.

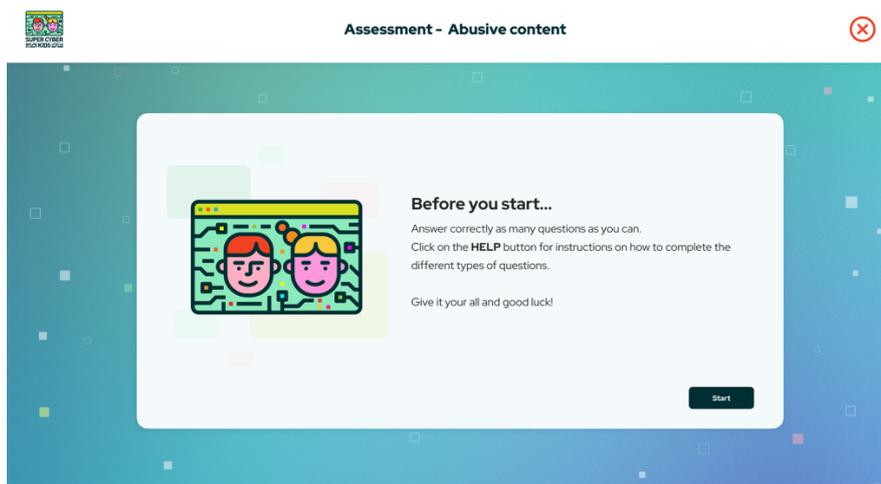


Figure 14: Start page of the test

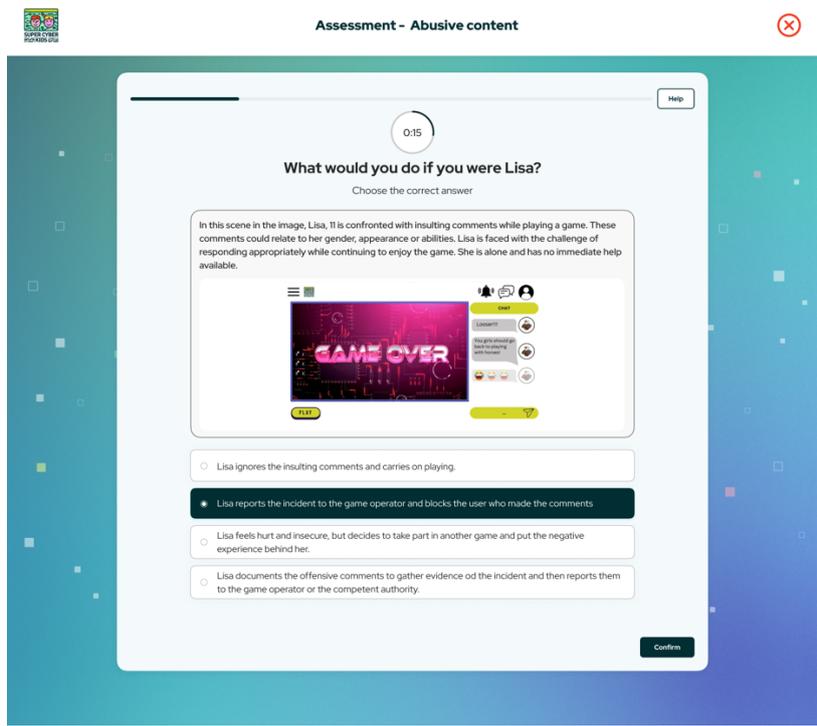


Figure 15: Example of a question in the test

We can set up a countdown for each question (optional), shown on the top of the window.

After the users have answered all the questions related to one domain, they are shown a window with the total number of correct answers out of the total number of questions.

The Initial test only shows the points achieved at the end, and no feedback on whether an answer is correct, so that when users do the Final test, they give answers based on what they have learned, not on what they remember from the Initial test. Once a module (consisting of 5 to 13 questions) has been completed, the user receives feedback on how many questions they have answered correctly. At the end of each module, the number of correctly answered questions is displayed. The user can then view the results and compare them with the Initial test at a later point.

The figure below shows the results of the Final test on the domain Abusive content, with complete feedback about correct / incorrect answers.



Assessment - Abusive content



Well done!
You completed the assessment.
5/7 correct answers

Question 1

What is a patch?

Throughout its lifetime, software will run into problems called bugs. A patch is the immediate fix to those problems. IT or end users can often download a patch from the software vendor's website. But the patch isn't necessarily the best fix for the problem, and the product's developers will often incorporate a more complete remediation when they do the next upgrade or full release of the software.

- A new medical app
- A software update that developers release to fix known security vulnerabilities.
- A security barrier between internal and external networks, designed to filter and block unauthorised traffic.
- A secure and encrypted network connection that allows users to access the internet or a private network confidentiality.

Question 2

Question 2

Lorem ipsum dolor sit amet consectetur. Enim nulla habitant pulvinar non congue arcu dictumst. Pretium augue cras aliquet tempus diam ut eu. Sed velit semper ipsum scelerisque bibendum. Urna porttitor faucibus risus urna sodales convallis tellus. Neque posuere neque posuere tincidunt pellentesque sed blandit lacus. Interdum amet phasellus convallis phasellus egestas sapien nisi sagittis.

- Answer 1
- Answer 2
- Answer 3
- Answer 4

Question 3

Figure 16: Results page at the end of the Final test

4.8 User profile

By clicking on the username at the top right-hand corner of the homepage users can access their profile page.

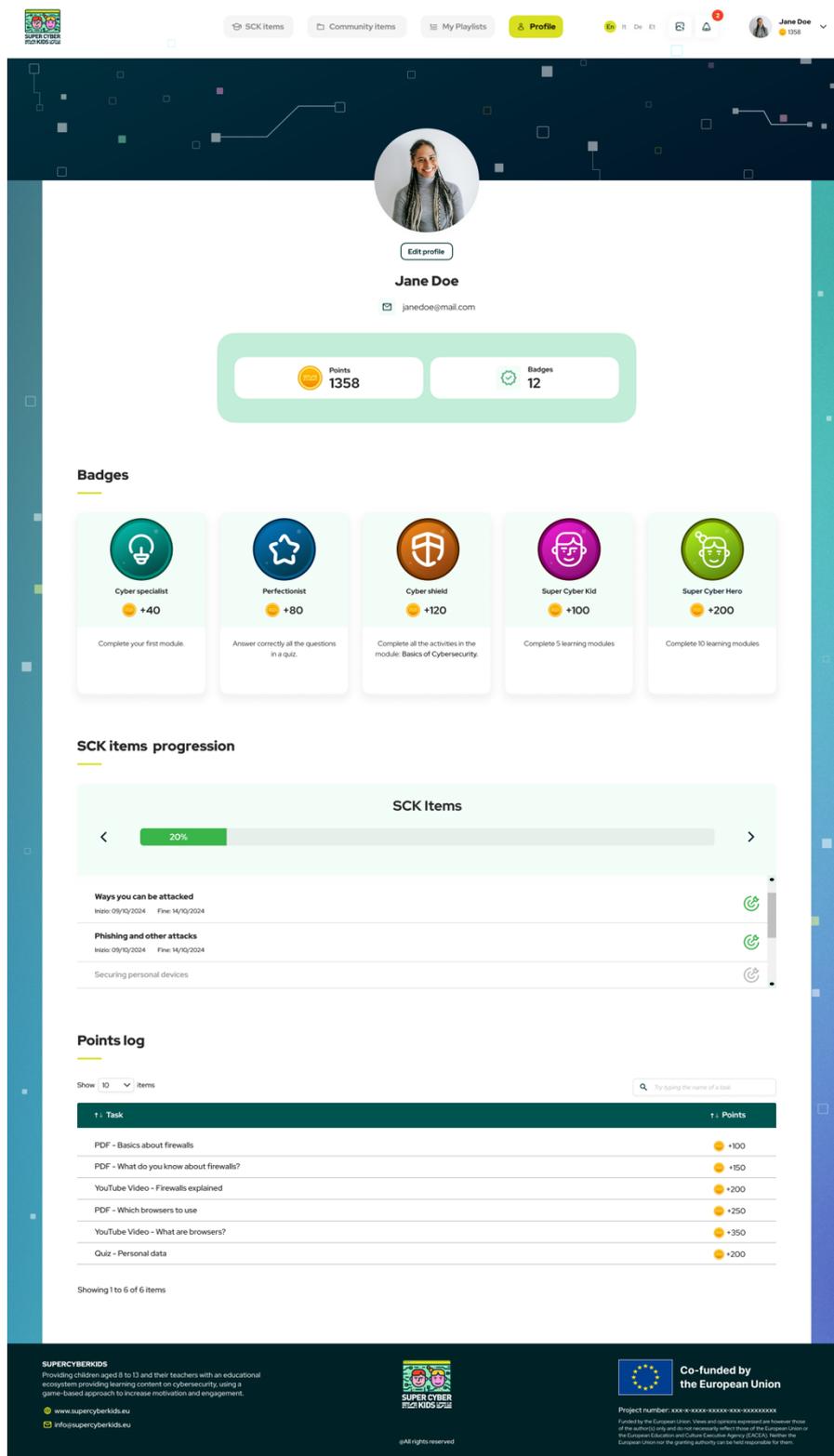


Figure 17: User Profile page

In this page it is possible to edit the profile, for example uploading a picture or changing username and password.

The platform can provide evidence of competence, such as a badge.

Badges can be tied to points for completing activities, opening links, downloading documents, successfully responding to quizzes and to performing activities in the platform (e.g. suggesting content, post ratings).

All the badges that the user has acquired by performing activities in the platform are shown in the Profile page. In the example shown in the figure above, this user has acquired the following badges [NOTE: they are just examples of possible badges]

- Cyber specialist: by completing one module for the first time
- Perfectionist: by giving correct answers to all questions in a quiz
- Cyber shield: by completing all the activities in the module “Basics of cybersecurity”
- SuperCyberKids: by completing all the activities in five modules
- SuperCyberKids Hero: by completing all the activities in ten modules.

In the Profile page users can also view how many SCK items (i.e. the 18 modules recommended by the project) have been used, and all the points gained performing activities in the platform.

4.9 Tutorial

When the users first enter the platform, they are shown a set of slides that explains the functioning of the platform. This Tutorial can be viewed again after the first login by clicking on the button in the top menu (red box in the figure below).



Figure 18: Button “Tutorial”

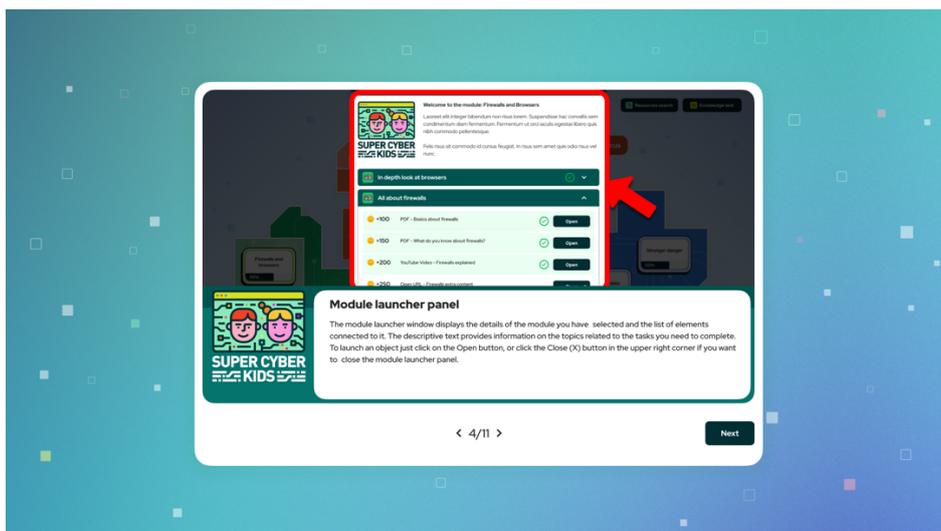


Figure 19: Tutorial

5 Launching games from the platform

There are currently two games included in the SuperCyberKids learning ecosystem about cybersecurity that can be accessed from the platform:

- “Spoofy” (see description in Deliverable 4.2)
- “Nabbovaldo and the Cyber Blackmail” (see description in Deliverable 4.1).

The games were made available respectively by SCK partners CGI Estonia and CNR. Both are free games that deal with teaching cybersecurity issues to roughly the same target age groups; however, they differ in the way the public can get them and play, since Spoofy can be played online or by downloading an app from Google Play or the App Store, whereas Nabbovaldo can only be played by downloading the app from the online stores.

For these reasons, these games cannot be embedded in the platform as internal resources (such as a document or video). While Nabbovaldo can share data (such as players starting the game, completing the game, completing levels) with the platform through appropriate APIs, Spoofy has been developed with a completely different approach, because it does not collect any data other than that the player has downloaded the game or that they have visited the game website. A feasibility study to share some data from Spoofy to the platform via APIs is currently underway.

At the moment of the release of the SuperCyberKids platform in October 2024 (month 22 of the project), the link to the external games Spoofy and Nabbovaldo is as follows:

- Spoofy: the platform links to Spoofy website <https://spoofy.ee/en>
- Nabbovaldo: the platform links to the Google Play or App Store pages where the game can be downloaded.

6 Privacy and security issues

The SuperCyberKids platform is hosted on servers managed by European Amazon Web Services (AWS), a cloud platform that offers a wide range of services for secure and scalable application hosting. Since AWS operates in Europe, they must comply with European data protection regulations, particularly the General Data Protection Regulation (GDPR), in order to ensure legal compliance and protect users' privacy.

Hosting on AWS in Europe

The SuperCyberKids platform and related services, such as the Python API for semantic search and the MySQL database (see section 2 above), are installed on servers hosted by a system infrastructure implemented using AWS EC2 (Elastic Compute Cloud) services. These servers are geographically located in Europe, and this ensures adequate protection so that data cannot be transferred outside the European Union.

There are advanced security settings implemented on the AWS servers that host the platform to protect users' data and ensure GDPR compliance. More specifically, these are the configurations in place:

1. **Physical and Cloud Security of AWS:** AWS data centres are certified according to international security standards (ISO 27001, SOC 2, etc.) and offer continuous 24/7 physical protection, ensuring that access to physical servers is monitored and protected against unauthorized intrusions.
2. **Data Residency:** Data residency within the EU ensures that all operations involving European users' data comply with GDPR. In this context, AWS provides tools for encrypting data and securely managing sensitive information.

Personal Data Protection and GDPR Compliance

To comply with GDPR, the platform implements several measures to protect personal data, both technically and organizationally:

1. **Data Encryption:** Data stored in the MySQL database is encrypted using advanced encryption protocols. This ensures that, even in the event of unauthorized access to the data, the information remains unreadable without decryption keys.
2. **Limited Database Access:** The MySQL database is only accessible from the EC2 instance running the SuperCyberKids platform and related APIs. The risk of data breaches is significantly reduced because no external connections can directly access the database.
3. **Secure Backups:** AWS guarantees periodic backups of the data made and stored in GDPR-compliant AWS regions, also using encryption to ensure the security and confidentiality of the information.

Communication Security

All communications between users and the platform are protected using HTTPS with SSL/TLS certificates. This means that the data transmitted between clients (e.g., user browsers) and the server is encrypted and protected from man-in-the-middle (MITM) attacks. AWS also offers as additional feature

the possibility to use integrated SSL certificate management, ensuring that encrypted connections are kept up to date and secure.

Application Security

The SuperCyberKids platform is a PHP-based platform, and therefore it is protected by various security tools designed to minimize the risk of cyberattacks.

1. **Wordfence Security:** The platform uses the Wordfence plugin, an advanced security system for WordPress, which offers a comprehensive suite of security tools.
2. **Google reCAPTCHA:** To protect registration forms from bots and spam, the platform uses Google reCAPTCHA, ensuring that only real users can interact with the registration and other public forms.