IO1: Internet of Things and Data Engineering Training Methodological Toolkit (eLearning smart digital labs)

for the Project Education 4.0: Living Labs for the Students of the Future (LLSF)
Contract number 2021-1-RO01-KA220-HED-000032176

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List of participants

Participant No *	Participant organisation name	Acronym	Country
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1. INTRODUCTION

Our world is changing fast. As the world continues to evolve, training institutes are globally preparing to keep up to date with the growing demands of the 21st century. Therefore, they try to explore new ways and use effective services to promote their training system and ensure students' upskilling [1]. In our dynamic and fast-growing learning environment, supportive services like Smart labs (SLs) have made huge progress in education sectors. Generally speaking, SLs are laboratories or spaces, located indoors and comprised of both the laboratory and non-laboratory spaces required to support industries and academia. As defined by [2], SLs are experimental laboratories that seek to encourage and facilitate open and collaborative practices, simulating real-life environments where the required Toolkits can be studied and subjected to experiments. In the context of education, SLs – which are also called Living Labs in some studies [3], [4], [5] – refer to user-centered ecosystems and supportive environments for innovation, research, exploration, experimentation, and creation that integrate (smart) systems, various (smart) equipment, toolkits, and/or solutions focused on teachers, students, and their demands [3].

In recent years, the notion of SLs has constantly been extended and redefined. Even though there is no universally agreed definition of SL, they have become well-known for the supportive services provided. For example, as information-communication- and technology-driven workspaces, they can integrate the resources, actors, and activities, needed for smart education (a technology-driven learning system). SLs can operate as intermediaries among actual users (e.g., teachers, students, researchers, and staff) to engage them in a systematic way as well as to help them join value creation and scale up innovation. Furthermore, SLs can create an open-source environment to be used for facilitating education, training, and learning; developing the networks; involving the users in the collaborative innovation process, and collaborative knowledge production; creating and testing concepts; and sharing methodologies and evidence-based knowledge [6], [7], [8].

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Opposed to traditional labs, SLs are more open, flexible, and adaptable to current needs. Predominantly, the mission of SLs is to provide, adapt, and make ready for use the environments, infrastructure, equipment (e.g., IoT), smart systems (e.g., smart grids), and Toolkits according to the latest advances and technological innovations in education, and the needs of users [3], [9]. (Training) Toolkits refer to a broad spectrum of needed tools, resources, and materials including but not limited to relevant tools, devices, hardware, software, sensors, instructions, practical advice, guidelines, procedures, practice, methods, documents, explainers, knowledge, procedures, information, and/or skills that support users at different stages of education, training, and learning [7], [10]. Both the physical and electronic/digital training Toolkits are purposefully designed to provide the possibility for making synergy between foundational (hard) skills and (soft) 21st-century skills.

SLs can be designed for and implemented in different scenarios such as face-to-face, distance, mobile, and blended learning [6], and they can be used for different purposes for example, increasing student-teacher interaction, supervising and monitoring students, controlling students' computers [11], user profile creation, and adaptation of learning content for different types of users [2]. Despite notable works performed and achievements obtained in this particular area, very few studies have reported the importance of SLs in (a) helping teachers design, develop, and deliver their training courses, and (b) supporting students to develop their skills. Additionally, we need to clarify how it can be accomplished in training institutes. Given that, the aim of this work is to introduce a specified SL called Smart Learning Lab (SLL) that on one side enables teachers to design and deliver their new or develop their current disciplines and training courses, on the other side supports students to develop their skills for future careers. The introduced SLL has been utilized for some concrete cases and tested in several EU projects.

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2. BASE CONCEPTS

Smart Lab (SL)- provides a supportive environment that enables students to, for example, use the provided training resources and materials; conduct research, investigation, and experimentation on the topics of interest; and engage in collaboration, communication, group discussion, and knowledge sharing with their peers, aiming to gain the needed skills and competences and then be prepared for their future jobs. This is a kind of modern approach and innovative training and learning service that intends to help students have an actual feel of the industry, make them compatible with industrial requirements, assist them in becoming effective and productive workforce, and help them in their placements. However, to optimize the approach and service, they should be initially adjusted and customized based on cultural and local needs [12].

In today's fast-changing world of technology and digital transformation in education, laboratories have a significant role to play. That is, they can provide an equipped environment to then take the opportunity to facilitate and promote the processes of, for example, providing an experimental foundation for understanding theoretical concepts, conducting practical tests, carrying out scientific research, developing innovation, advancing technologies according to current demands, and developing students' skills, i.e., problem-solving, and critical-thinking skills.

As the demands and expectations of industries, academia, and users are continually changing, the new generation of labs (e.g., industrial automation laboratories, living labs, virtual cloud labs, digital labs, and virtual reality labs) are accordingly evolving. Smart Lab (as another example) is, indeed, a supportive environment, high-performance laboratory, and open workspace equipped with needed Toolkits and tools designed to enable and expedite safe and efficient world-class science and experimentation, as well as enhance effective communication and successful engagement in instruction, curriculum, and learning.

Smart Lab can facilitate the provision of all kinds of learning, including traditional face-to-face and distance learning, and also offers possibilities for further development of mobile learning,

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which is rapidly spreading in all fields of education. Smart Labs, thus, can be built in the form of physical, virtual/mobile, or mixed labs that promote training and learning courses and activities in both the traditional mode (face-to-face) and the remote mode, depending on the training structure and purpose. Therefore, Smart Labs introduce and offer equipped, flexible, and dynamic spaces for users (e.g., teachers and students), intending to facilitate access to a wide variety of training and learning materials and resources; expedite the investigation, research, and experimentation process; promote collaboration and knowledge sharing; develop students' skills, etc.

Living Lab (LL) - the term "living lab" is at risk of becoming a buzzword in the research, innovation, and collaboration domain, since it lacks a consistent or commonly accepted definition. A vast range of activities, indeed, can be fulfilled under the umbrella of living labs, and each in turn has its own research perspective and methodology. According to [13, 14] LL can refer to one or more of the following attributes:

- It is an open-innovation ecosystem and research center for sensing, prototyping, validating, and refining a variety of solutions by involving multiple stakeholders.
- It is a space that by taking advantage of knowledge sharing can be used for developing a project, product, service, and/or system.
- It is a participatory methodology relying on collaboration between various agents of a system.
- It involves end-users in the product development process.

As a type of open and flexible laboratory, LLs are basically set up to generate ideas, develop research and experiments around the ideas, then validate the findings and make them documentation to lastly provide (new) products or services. These processes occur in the real situations where the right competences and stakeholders in a LL (e.g., researchers, designers, innovators, entrepreneurs, developers, academics, associations, SMEs, and also consumers) come together at the right time to create added value and deliver something new in a process of co-creation. Developing all these processes is necessary before introducing the idea, innovation, product, or service to the market or society. Each stakeholder can take advantage

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of provided opportunities in different ways. For instance, enterprises not only can get new ideas but also increase the return on their investments, researchers can extend their research and development activities, and consumers can get innovative products and services. In addition, a multitude of businesses has reported that not only did their products and services become better, but they had shorter development time due to their collaboration with the LLs.

Toolkit - is an assembly of tailored tools and/or a special set of basic components, guidelines, templates, adaptable resources, and software utilities that provide practical solutions, advice, guidance, processes, and information for a particular purpose [15]. In the context of training and learning, a toolkit refers to a collection of original and/or revised resources, training classes, online courses, training materials, web links, instructional methods, models, techniques, publications, knowledge, tools, devices, and applications that can be used to, for example, translate theory into practice, expedite the translation of evidence into practice, facilitate practice change, give actionable learning paths, upskill trainers and trainees, support learners and learning strategies and skills, as well as improve the design, implementation, delivery, and evaluation of training courses [15, 16].

There are different types of Toolkits (e.g., education toolkits, technical toolkits, design toolkits, collective action toolkits official toolkits, expert toolkits, and basic toolkits) and they are often created and used for different purposes (e.g., language model training, standardized reinforcement learning, and facilitating the engagement with learning outcomes), which may focus on a specific group of users (e.g., higher education institutes and healthcare providers).

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3. CONCEPTUAL MODEL

Our proposed model—which is demonstrated in Figure 1—simply conceptualizes and represents a typical SL and a general package of training Toolkits that can potentially support users. The package comprises of 7 groups of Toolkits that classify some identified Toolkits according to their application and functional capabilities. It is important to note that the number of groups and their associated Toolkits and instances should be adjusted according to the goals and requirements of the concrete case. As an example, in reliance on our literature review, we added one more group (group 8) to the list, aiming to make the model more comprehensive.

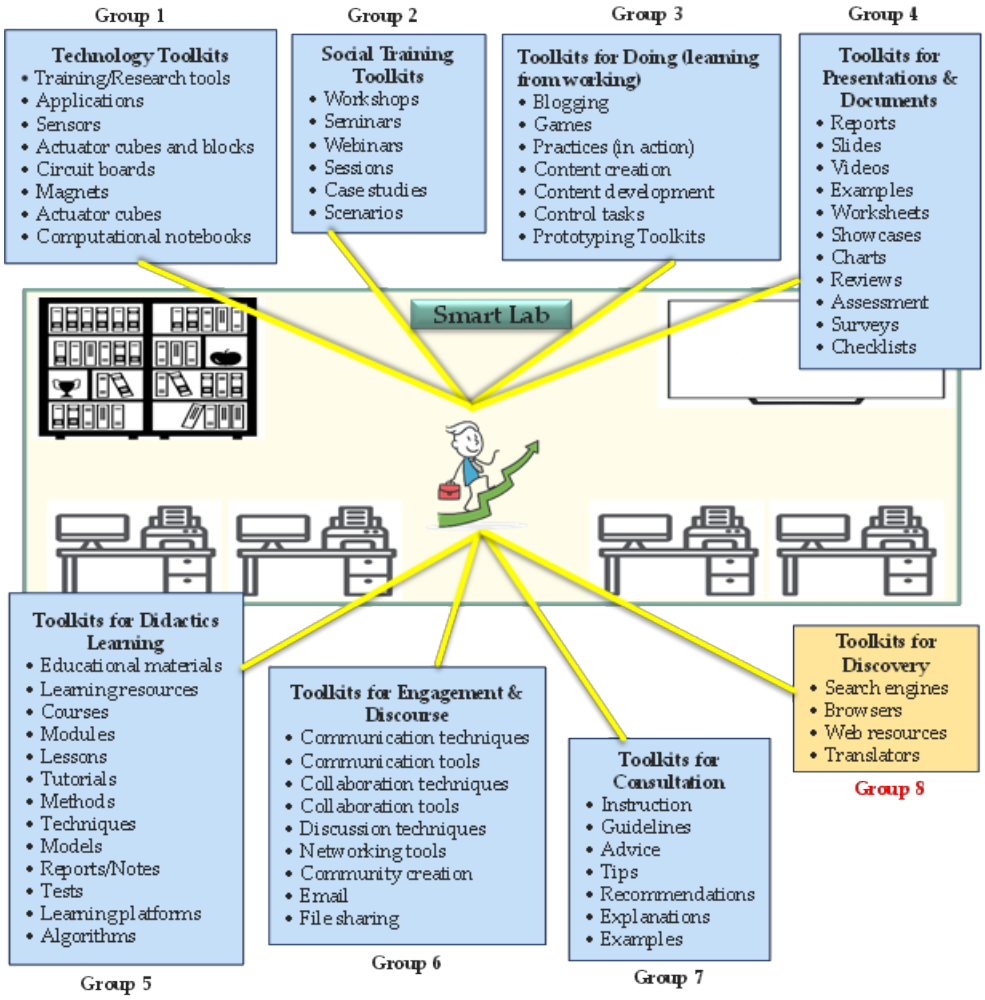

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Figure 1. Proposed conceptual model for creating a package of training Toolkits in the Smart Labs.

It should be emphasized that our conceptual model is proposed to guide the educational institutes and faculty members who want to design and build up their own package of training Toolkits for supporting specific discipline(s)/module courses and developing students' skills, which are not often included in traditional education systems.

○ 3.1 Instantiation for the Toolkit—B-Health Box

Nowadays, many people around the world suffer from different types of physiological and posture-related problems caused not only by the incorrect execution of their work but also by not receiving the needed advice and/or corrective measures. To take a step in solving this problem, the B-Health Box Toolkit was designed, which relies on posture data collection and uses smart sensors to monitor students' physical activity and their posture. The idea is to trigger real-time corrective notifications to students (users), intending to reduce the risk of physical problems and injury that might be imposed on them as a result of not taking correct physical positions. The notification might be coupled with some advice and useful information (e.g., to correct their posture or relax their shoulders and back muscles) that indicates the causes affecting their physical condition, aiming to provide preventive measures within their daily environment.

The Toolkit also aims to help students learn how to harvest data from IoT devices and how to simulate human intelligence processes by machines, especially computer systems. The knowledge and skills gained in this way enable students to program machine learning algorithms that can automatically detect whether or not the student's posture is correct.

Figure 2 demonstrates the main materials used in this Toolkit. The image on the left side of the Figure shows the B-Health Box; the image in the center shows the Physiosense posture sensor: the sensor with the case (upper image) and the Printed Circuit Board (PCB)—(below image); and the image on the right side shows the T-shirt (to be used by the student).

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Figure 2. B-Health Box, Physiosense Posture Sensors, and T-shirt.

Figure 3 demonstrates the package of training Toolkits provided by B-Health Box and clarifies the way in which this Toolkit can be used to help students develop their skills.

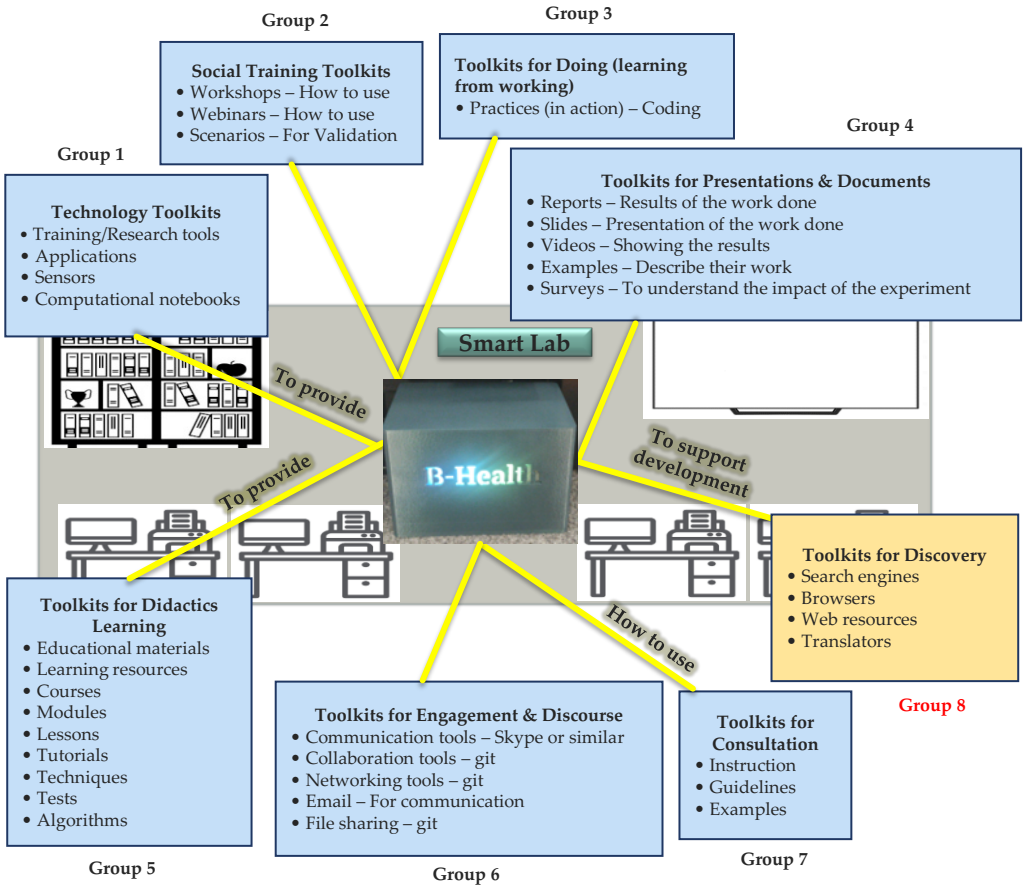

Figure 3. Package of training Toolkits provided by B-Health Box implementation.

To give an example, the B-Health Box can 'provide' students with at least 4 types of technology Toolkits (through group 1) namely, training/research tools, applications, sensors, and computational notebooks. Each of these technology Toolkits can in turn support students in developing their skills in the fields of IoT and AI.

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It should be added that this model, at this stage of development, faces two main limitations. The first limitation is with the number of applications of the model. That is, the model was only applied to our proposed services and solutions, although it needs to be validated by further applications. Second, the model was limited to the contexts of AI, IoT, OS, and interoperability. However, it should be applied to and tested in other contexts and fields of study.

○ 3.2. Using B-Health Box Toolkit

To make the connection between the B-Health Box and the user, one of the Phisiosense posture sensors should be placed in the pocket (designed for this purpose) of the T-shirt (used by the student), below the neck and between the shoulders, and another one in his/her lower back. The Physiosense posture sensors were developed to be connected via Bluetooth protocol. With this protocol, the students can use the sensors on their personal cell phones and also benefit from the Citizen Hub application. This application allows the students to receive feedback from the Physiosense posture sensors, indicating—on their cellphones every time—that they have an incorrect posture. To detect the students' posture, we use an IMU (Inertial Measurement Unit) sensor. More specifically, we apply the accelerometer sensor to use the three axes for detecting posture variations. To identify the incorrect posture, we use two Physiosense posture sensors that are placed in the pockets, as mentioned above. In this way, we can check the inclination of the back more accurately and compare the inclination between the two sensors. With this approach, it is possible to verify the inclination of the posture by using two of the three considered axes. The two Physiosense sensors are used to make a correlation between the two axes, and in this way, it is possible to verify the vertical inclination of the back and give warnings whenever one of the students leans forward (representing an incorrect posture). At the same time, the horizontal axis of the sensors starts checking to identify strange positions that the students might put on their backs, for example, when the back is not aligned with the body (see Figure 7). After collecting the data from the Physiosense posture sensors through the B-Health Box, it is necessary to process that data. In

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this way, the students will have to develop an AI algorithm per group of students that identifies when a student has an incorrect posture. Furthermore, it sends him/her warning notifications whenever it occurs. The related AI algorithm will be developed in Python. At the end, the students will be able to use the B-Health Box to execute the components, so that their posture will appear in real time on a monitor as shown in Figure 4.

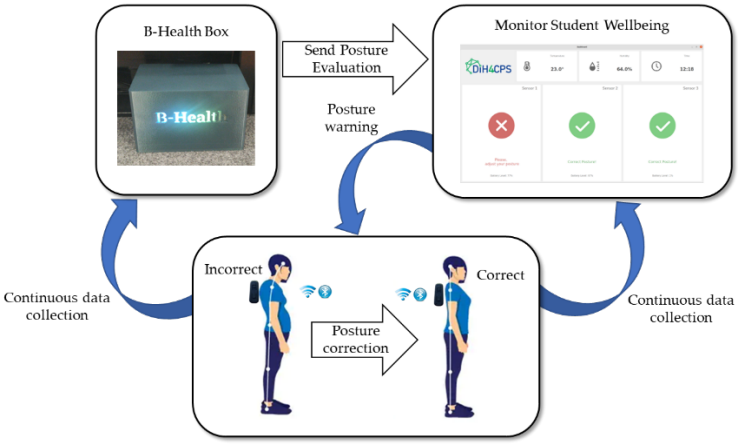

Figure 4. B-Health Box implementation.

The B-Health Box contains a Raspberry Pi 4, and the students will learn to work in Linux. That is, they have to develop Python code to communicate with the Physiosense posture sensors through Bluetooth. Thus, they need to learn the Bluetooth communication protocol to understand how it works and how to program it. The developed code must connect to the sensors and start receiving data in real-time that will be saved in a csv file (comma-separated values—https://en.wikipedia.org/wiki/Comma-separated_values). Given that, this Toolkit helps students develop code components for the B-Health Box capable of communicating with the Physiosense posture sensors through the Bluetooth communication protocol and of receiving in real time the data from the sensors that will be later used by an algorithm developed by students. Therefore, this Toolkit sends a visual warning to the students when their postures are incorrect, and in this way, the students can proceed to the placement of the correct posture. This section covers the sixth stage of our methodology.

The Toolkit is a self-contained problem box with known parameters. It provides a concise and clear development platform to explore real-world conditions for Bluetooth, IoT, and Data

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Collection. The Toolkit is a ready-to-use solution, which should free the teacher to concentrate on the tasks to be presented to the students.

○ 3.3. Instantiation for Discipline and Module Course

To demonstrate the usefulness and effectiveness of our proposed conceptual model for developing disciplines and module courses, we took the opportunity to apply them in the LLSF project (project education 4.0: living labs for the students of the future).

NOVA University of Lisbon, as a partner involved in the project, has adapted and applied the proposed conceptual model for upskilling a number of students and developing a discipline delivered by the Centre of Technology and Systems (CTS). CTS is located in the Faculty of Science and Technology (FCT) of NOVA University of Lisbon and its mission is to carry out fundamental and applied research, advanced training, dissemination of knowledge, and encouragement of technology transfer in the main areas of Electrical and Computer Engineering (EEC).

The considered discipline for development is Architecture for Integration of Systems (AIS), which aims to enhance students' understanding of the whys and hows of today's common problems at the application and business levels, which are directly or indirectly caused by interoperability difficulties. The discipline offers a module course that helps students develop their skills and capabilities related to IoT and AI, as well as their research and technical solutions for interoperability problems. Accordingly, the module course provides several related syllabuses, including an introduction to the course, an interoperability module, an IoT module, an Operation System (OS) module, an AI module, and a practical module. This module course, in addition to providing theoretical material (through the syllabuses), provides some opportunities for students to develop their skills practically in Linux and Python by means of connection to a specified Smart Lab and working with the B-Health Box and its sensors and controllers, which were mentioned earlier.

It should be mentioned that a total of 30 master's students who took the AIS discipline were given access to the Smart Lab and allowed to test the B-Health Box. Having evaluated the

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feedback of this group of students, another group of master's students will then test the B-Health Box, aiming to improve any weaknesses that might be found. NOVA University of Lisbon will then ask the students of the other 4 universities that are partners in the project to test the B-Health Box. The direct beneficiaries who test the B-Health Box are around 200 MSc students and 6 PhD students. The B-Health Box will then be tested by other types of users, such as teachers and stakeholders of the project.

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4. DISTRIBUTED ELEARNING TRAINING PLATFORM FOR INTERNET OF THINGS AND DATA ENGINEERING (INTER-CONNNECTED LIVING LABS)

In the rapidly advancing landscape of technology, the emergence of the Internet of Things (IoT) and Data Engineering has ushered in a new era of connectivity and innovation. The amalgamation of these technologies holds immense potential, not just in shaping our digital future, but also in redefining how we learn and adapt to this ever-changing technological paradigm. At the heart of this transformation lies the concept of a Distributed eLearning Training Platform, a revolutionary initiative designed to harness the power of interconnected living labs.

In this interconnected world, where devices, systems, and data sources communicate seamlessly, the need for a specialized training platform becomes paramount. The Distributed eLearning Training Platform for the Internet of Things and Data Engineering stands as a beacon of knowledge in this digital age. It serves as a virtual nexus where learners, educators, and industry experts converge to explore the intricacies of IoT and Data Engineering. What sets this platform apart is its innovative approach — it extends beyond traditional learning boundaries, embracing the concept of interconnected living labs. This interconnectedness not only mirrors the real-world IoT ecosystems but also provides learners with hands-on, immersive experiences.

Through this distributed eLearning platform, learners are not just passive recipients of information; they are active participants, engaging with live data streams, experimenting with IoT devices, and delving deep into the intricacies of data engineering. As we delve further into this exploration, we will uncover the myriad ways in which this platform revolutionizes learning, fosters collaboration, and prepares individuals to navigate the complexities of our interconnected future.

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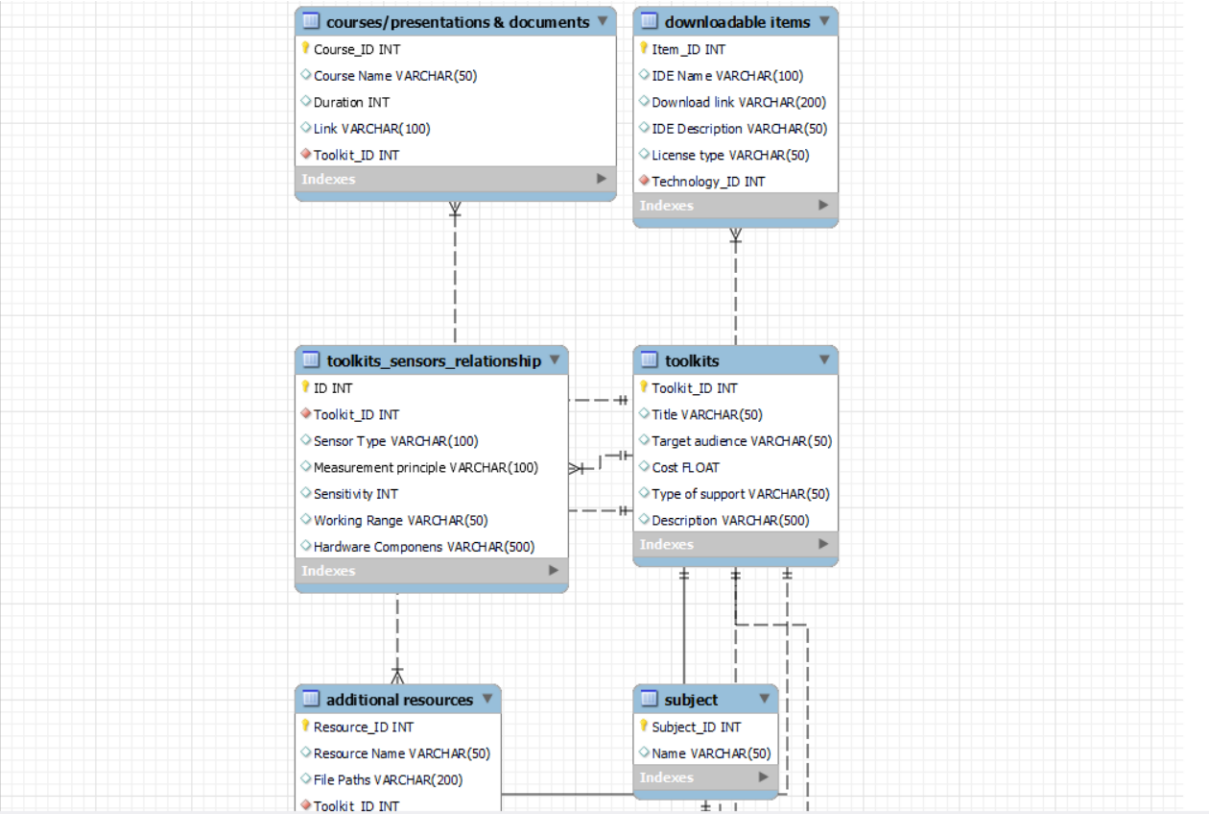
○ 4.1. Platform Creation and Development with DJANGO

For the user interface (UI) development, it was employed the Django framework to handle the backend functionality, while for the frontend, it was harnessed the power of CSS, specifically leveraging Bootstrap themes, and HTML.

The development process commenced by establishing a new app within the project, aptly named "toolkits." Subsequently, it was defined two distinct superuser accounts. The first superuser served as the initial administrator, bearing primary administrative responsibilities. The second superuser, known as 'user,' was created to facilitate the mentor's engagement with the system.

With these foundations in place, it was embarked on the creation of the models. The models.py module served as the repository for these class definitions. The attributes within these classes were meticulously structured to mirror the corresponding fields within the MariaDB, ensuring a seamless and consistent data schema (See next Figure).



The intended rigorous alignment between the Django models and the MariaDB schema guarantees the accuracy and integrity of the data it was managed within the application.

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The home page on the platform is designed to deliver a visually appealing and well-structured user experience. To achieve this, it was implemented the following components and strategies:

- *Modular Templates*: It was adopted a modular approach to template design. The content displayed on the home page is composed of segments originating from separate template files, such as carousel.html and navbar.html. These templates are included within the base.html to ensure a consistent and organized structure across the site.
- *Base HTML*: The base.html serves as the foundational template that encapsulates the common structural elements and styles shared by all pages on the site. It incorporates Bootstrap's Content Delivery Network (CDN) for enhanced rendering and styling, which ensures a visually pleasing and responsive design. This includes the usage of Bootstrap classes and components to achieve a polished appearance.
- *Carousel Component*: The carousel.html template contains the necessary code and content to create an engaging carousel on the home page as well as other features displayed below (interactive buttons that redirect the user to the Toolkits page).
- *Navbar Component*: The navbar.html template holds the navigation bar structure. Navigation bars are vital for user interaction, enabling seamless access to different sections of the site. It was implemented a user-friendly and responsive navigation, keeping Bootstrap's capabilities in mind.

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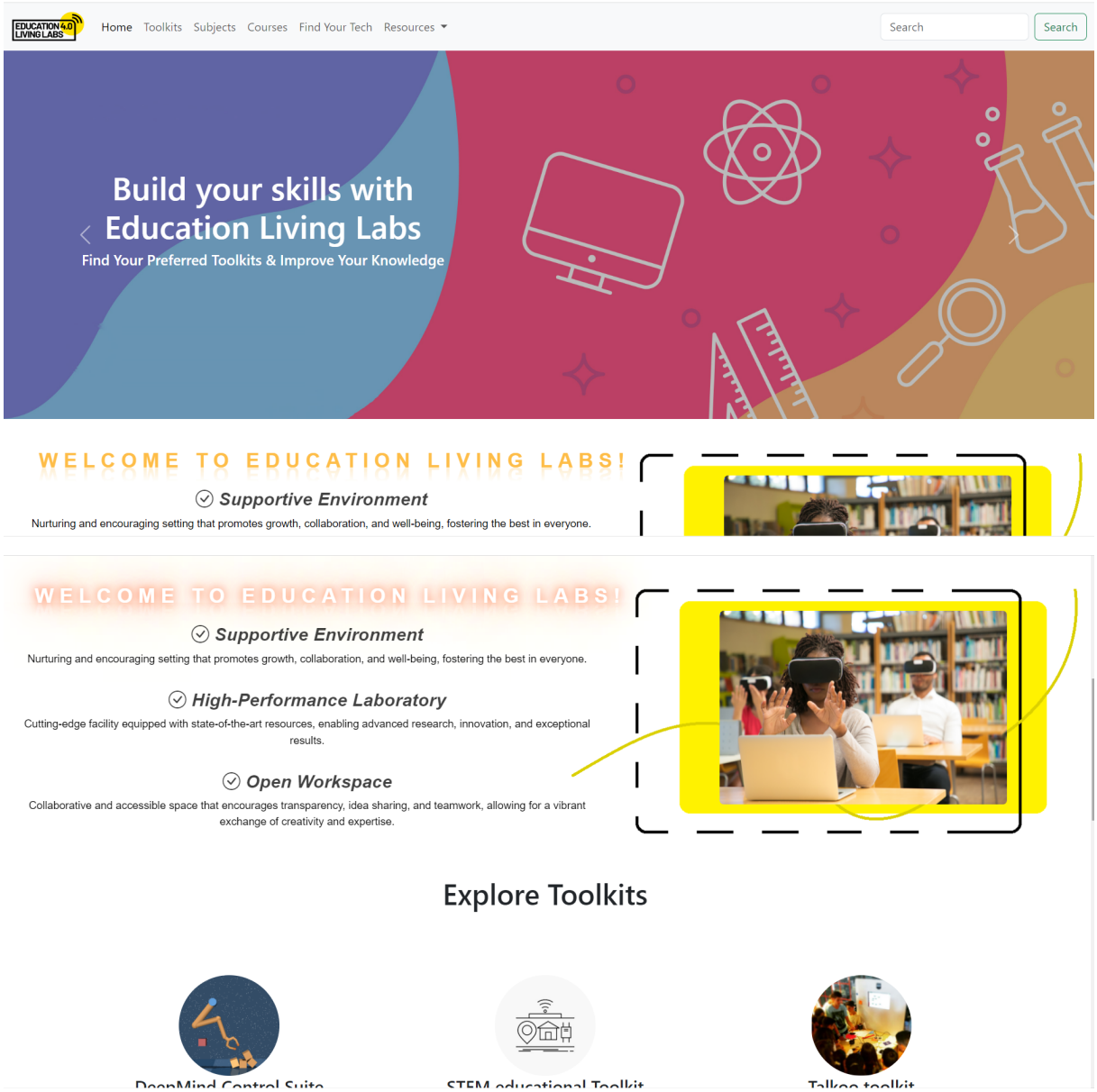

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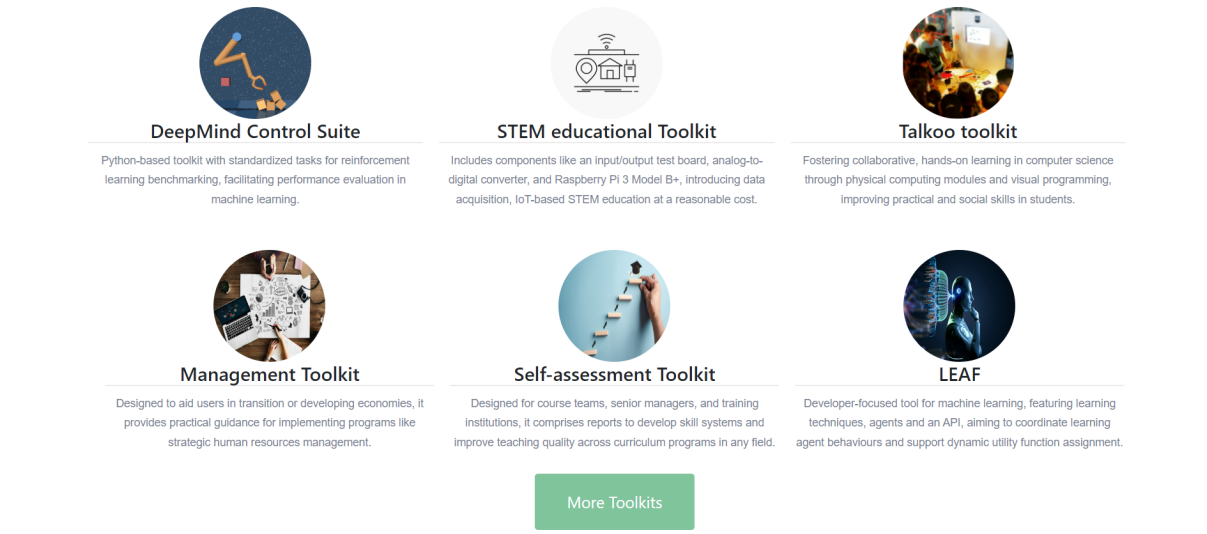

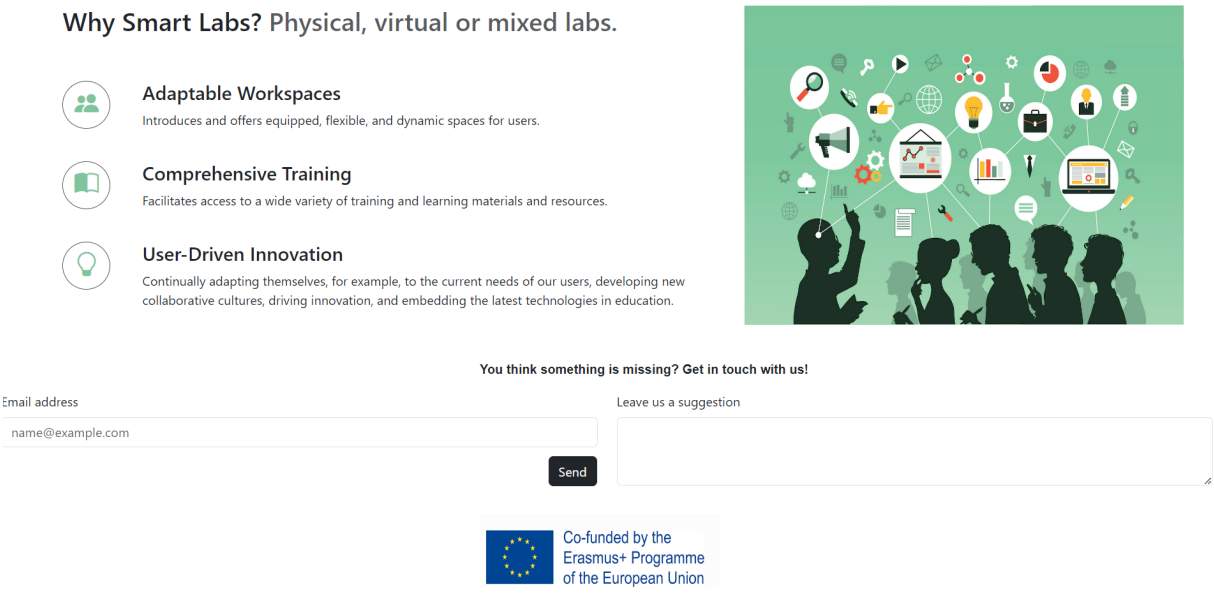

The platform incorporates a user-friendly and interactive search bar on every page, allowing users to easily access resources that align with their preferences. Here's how it works:

- *Interactive Search Bar*: The interactive search bar is prominently displayed on all pages of the website. Users can input their search queries into this bar.
- *Search Functionality*: When a user enters their search query and initiates the search, the system processes the request and retrieves relevant resources from the database. This search functionality encompasses all relevant data on the platform, ensuring comprehensive results.

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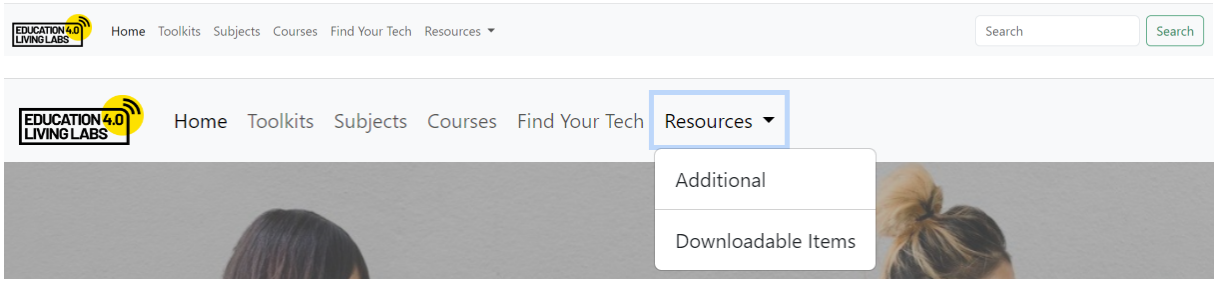
- *Search Results*: The results are then displayed on a dedicated page or section, showing all resources that match the user's search criteria. These results are presented in an organized and user-friendly manner, making it easy for users to explore and access the resources that are of interest to them.



The website's navigation is designed to provide users with easy access to all the key pages and resources. Here is how the NavBar facilitates seamless navigation:

1. *Home*: The "Home" option takes users back to the homepage, providing a starting point for their exploration.
2. *Toolkits*: Users can click on "Toolkits" to access a dedicated page where they can explore a wide range of toolkits, each designed to address specific needs and goals.
3. *Subjects*: "Subjects" leads users to a page where they can discover information related to various subjects, helping them find resources specific to their areas of interest.
4. *Courses*: By clicking on "Courses," users can access information about different courses available in the platform, enhancing their knowledge and skills.
5. *Find Your Tech*: This dropdown menu contains two important sections:
   - Technology Integration: Users can delve into the realm of technology integration, exploring how different technologies can be combined to create innovative solutions.
   - Sensors: This section focuses on sensors and their applications, allowing users to gain insights into the world of sensing technologies.
6. *Resources*: The "Resources" dropdown menu offers two valuable subsections:

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- Additional Resources: Users can find supplementary resources to further enhance their understanding and knowledge.
- Downloadable Items: This section provides access to downloadable items, which may include document files.

The NavBar is user-centric, ensuring that visitors can efficiently navigate the site to access the content and resources most relevant to them. Whether they are seeking toolkits, subjects, courses, technology integration insights, sensor information, additional resources, or downloadable items, the intuitive navigation options make their journey smooth and enjoyable.

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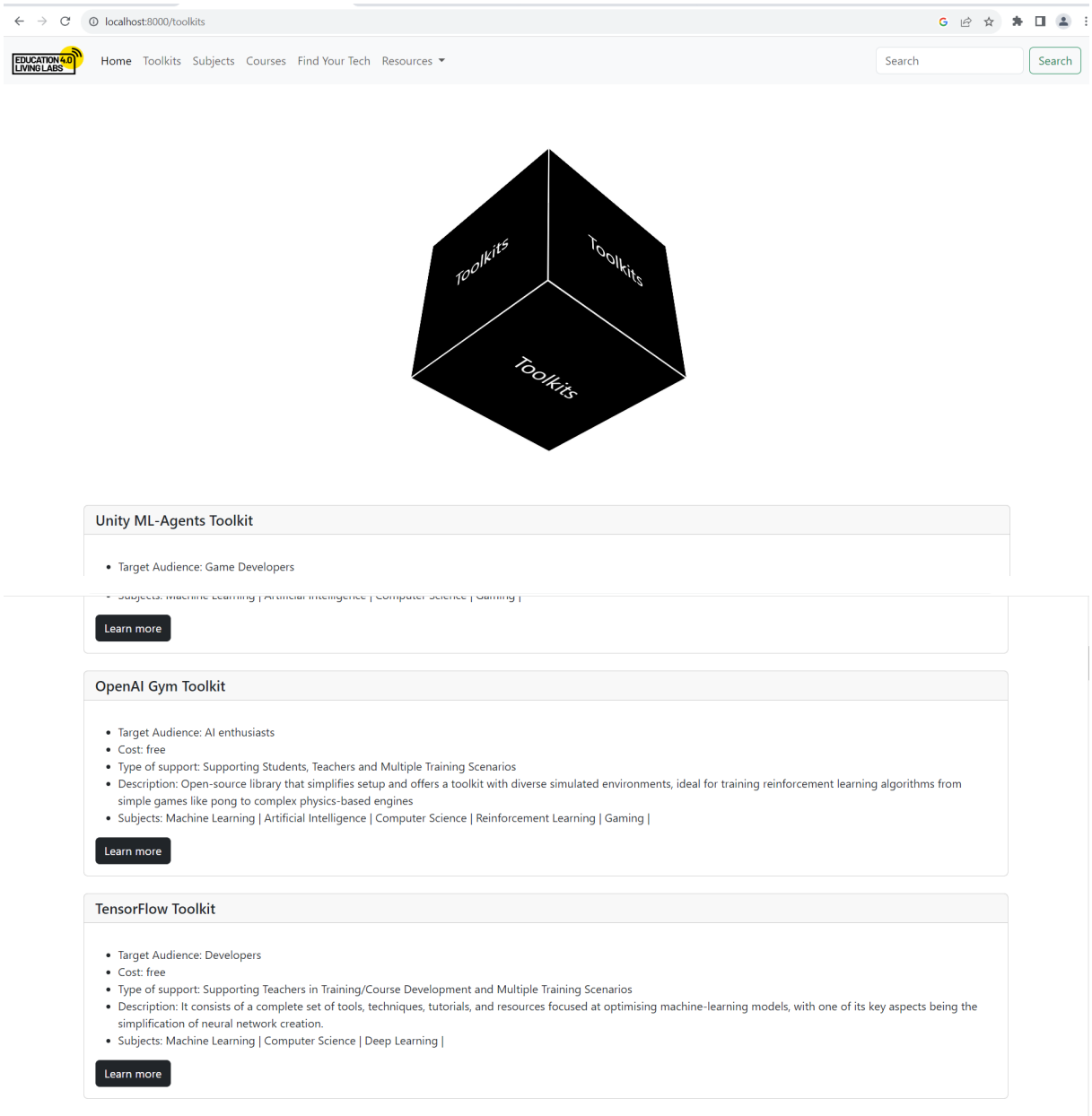

Each toolkit presented in the platform includes detailed information to help users understand its purpose and features. Additionally, it was offered a convenient "Learn More" button for quick access to the toolkit's official website or documentation. This approach ensures that users can make informed decisions about which toolkit best suits their needs, and it allows them to seamlessly explore further details and resources directly from the toolkit's source.

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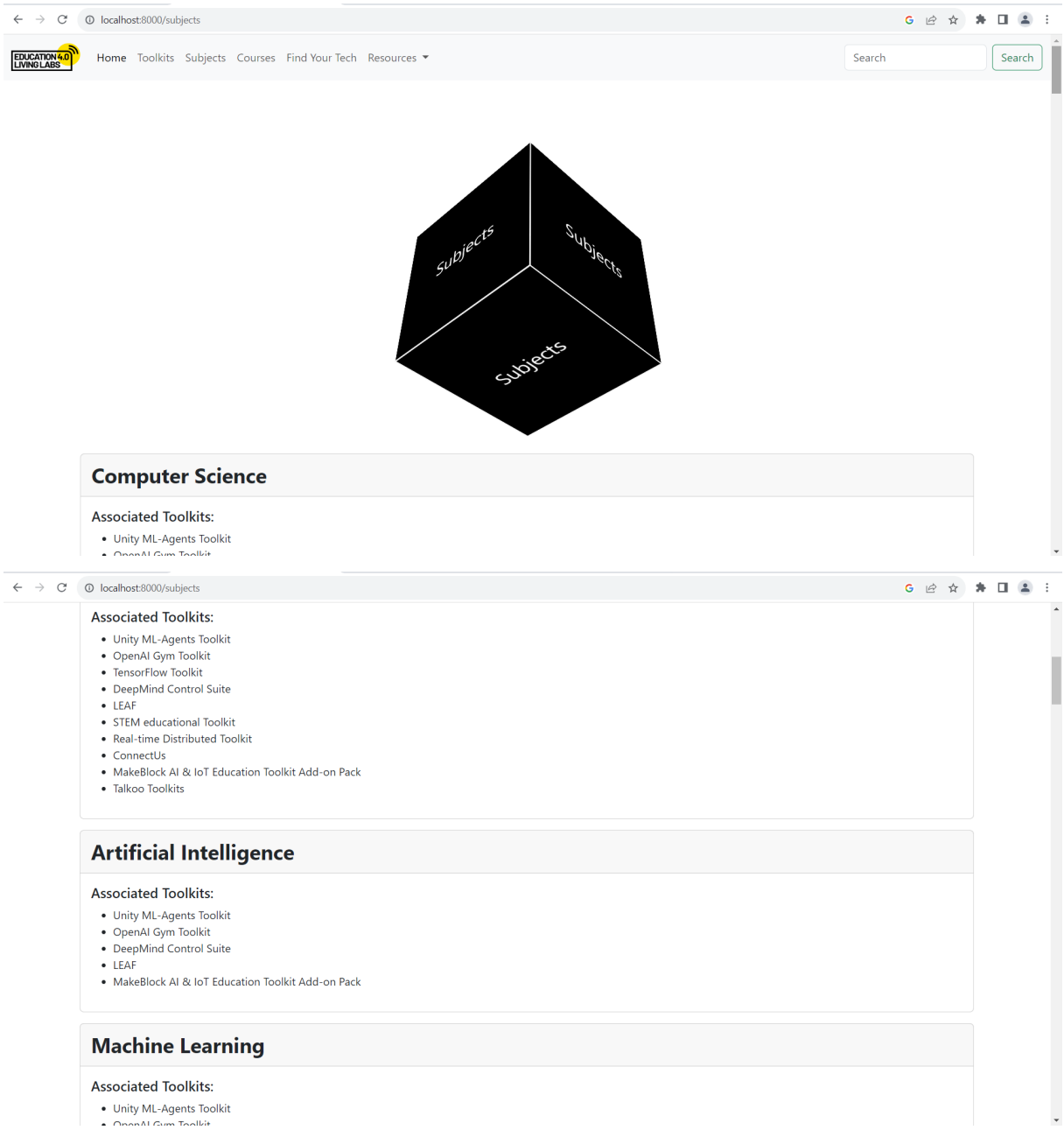

The "Subjects" page is designed to provide users with a curated list of toolkits that are categorized by specific subjects. The goal is to enhance the user experience by simplifying the process of finding toolkits related to their chosen subjects. It was believed that by categorizing toolkits in this way, users can quickly identify and access the tools that best align with their specific needs and research objectives. This feature adds value to the platform by offering users a more targeted and user-friendly experience.

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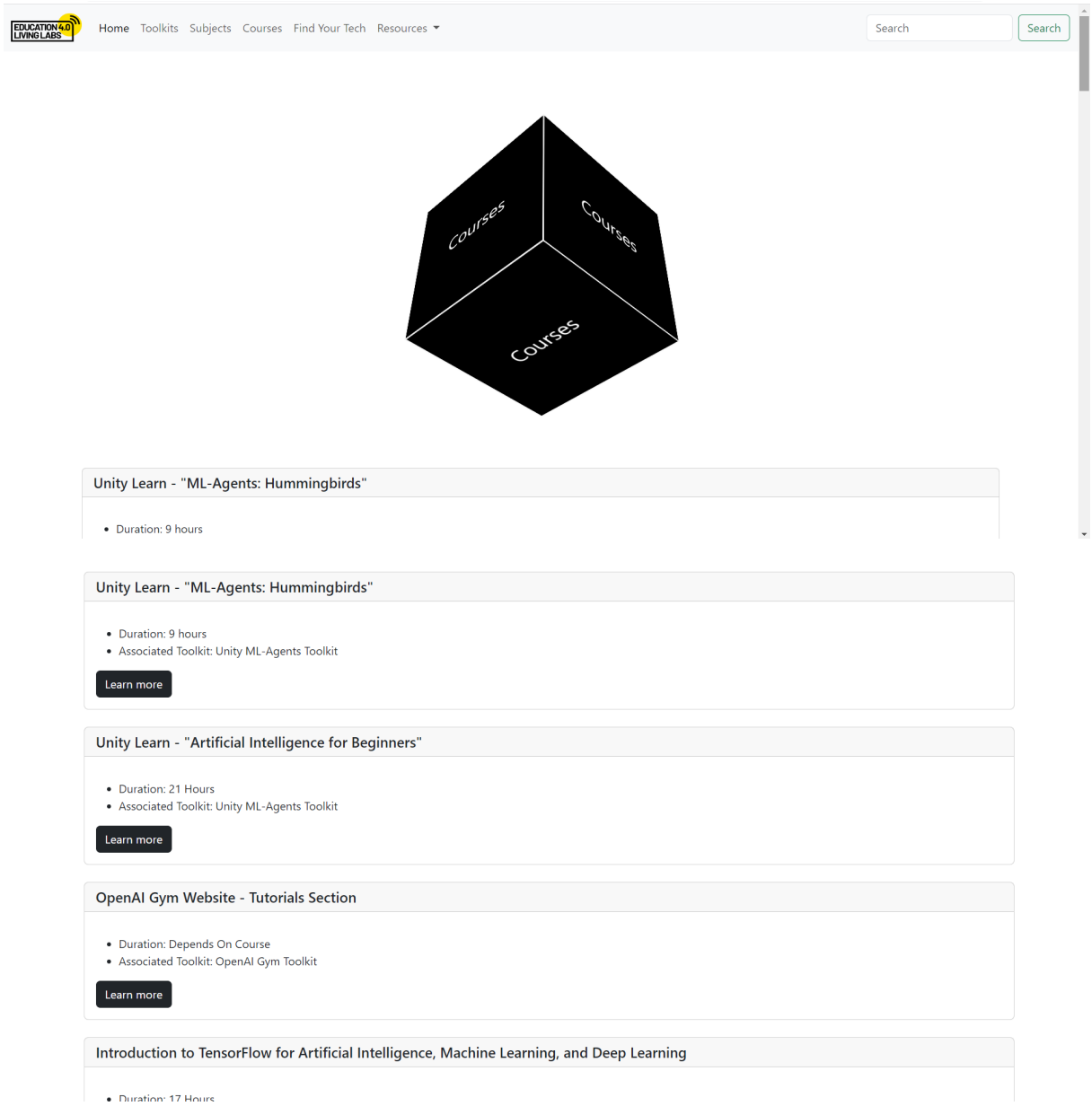

On the "Courses" page, it was provide detailed information about facultative toolkits work, allowing users to explore these courses and resources further. Users can access additional information about each course by clicking the "Learn more" button. This feature empowers users to make informed decisions about which courses they want to pursue and helps them better understand the content and benefits of each course.

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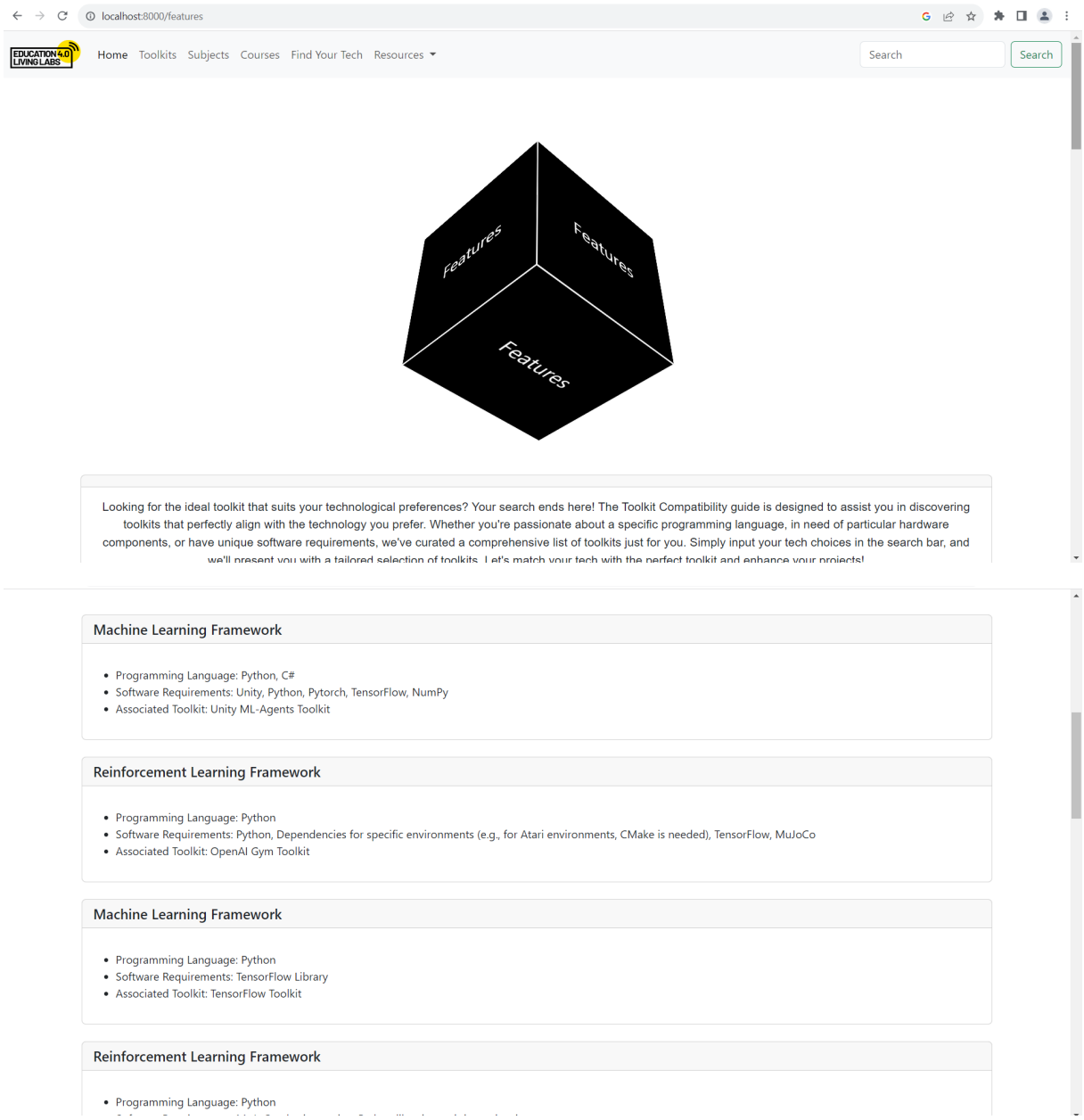

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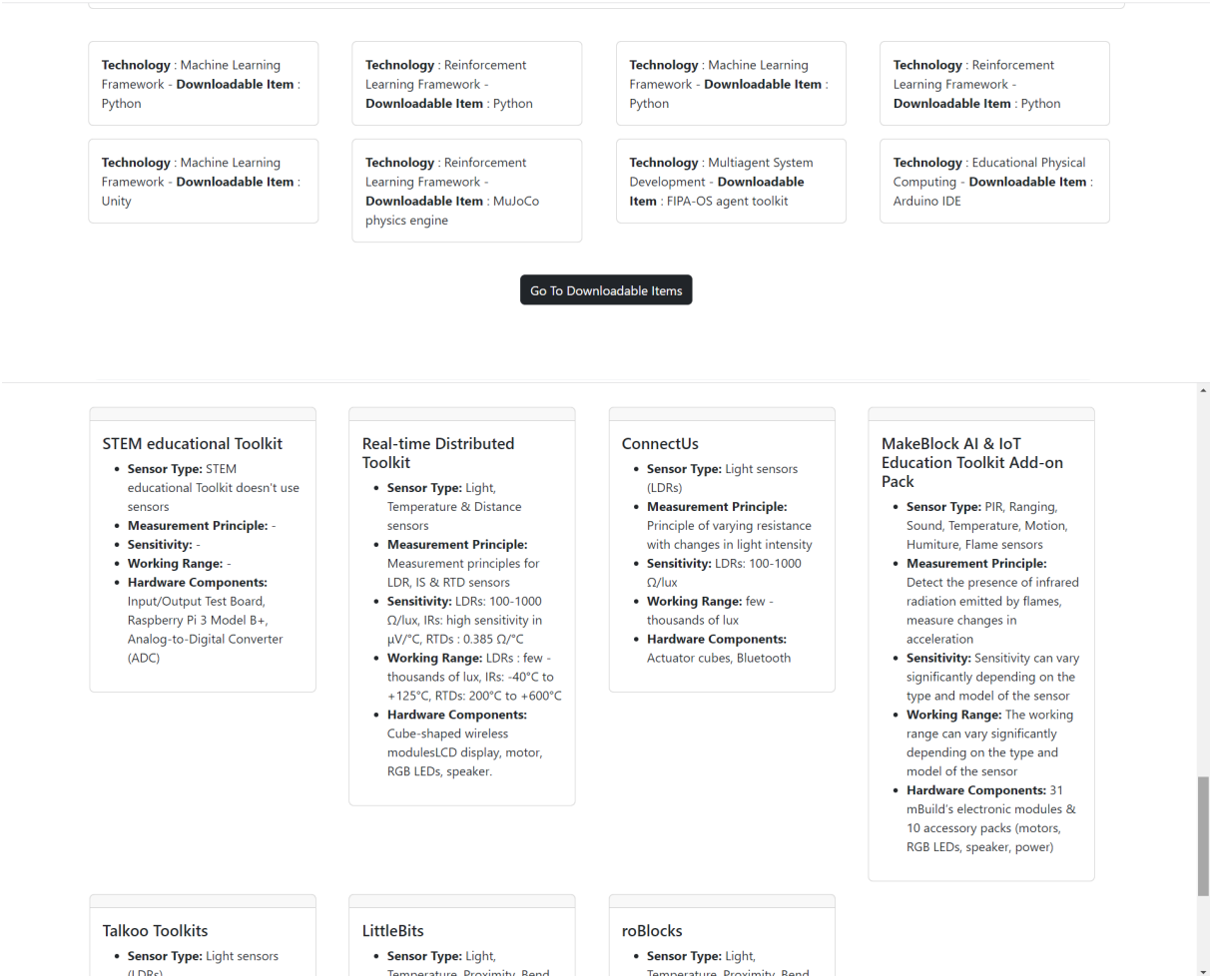

The "Find Your Tech" page serves as a valuable resource for users to explore the technology integrations within each toolkit. It provides detailed information about how each technology is linked to downloadable items and lists the sensors and hardware components contained in certain toolkits. This information helps users understand the technological aspects of the toolkits and the associated resources available. By accessing this page, users can make more informed decisions about which toolkits align with their specific technological needs.

The integration of technology into toolkits is a critical aspect of this platform, thus a comprehensive overview of these integrations is provided. This includes information on the technology's relevance to each toolkit, how it enhances the toolkit's capabilities, and the resources available for further exploration.

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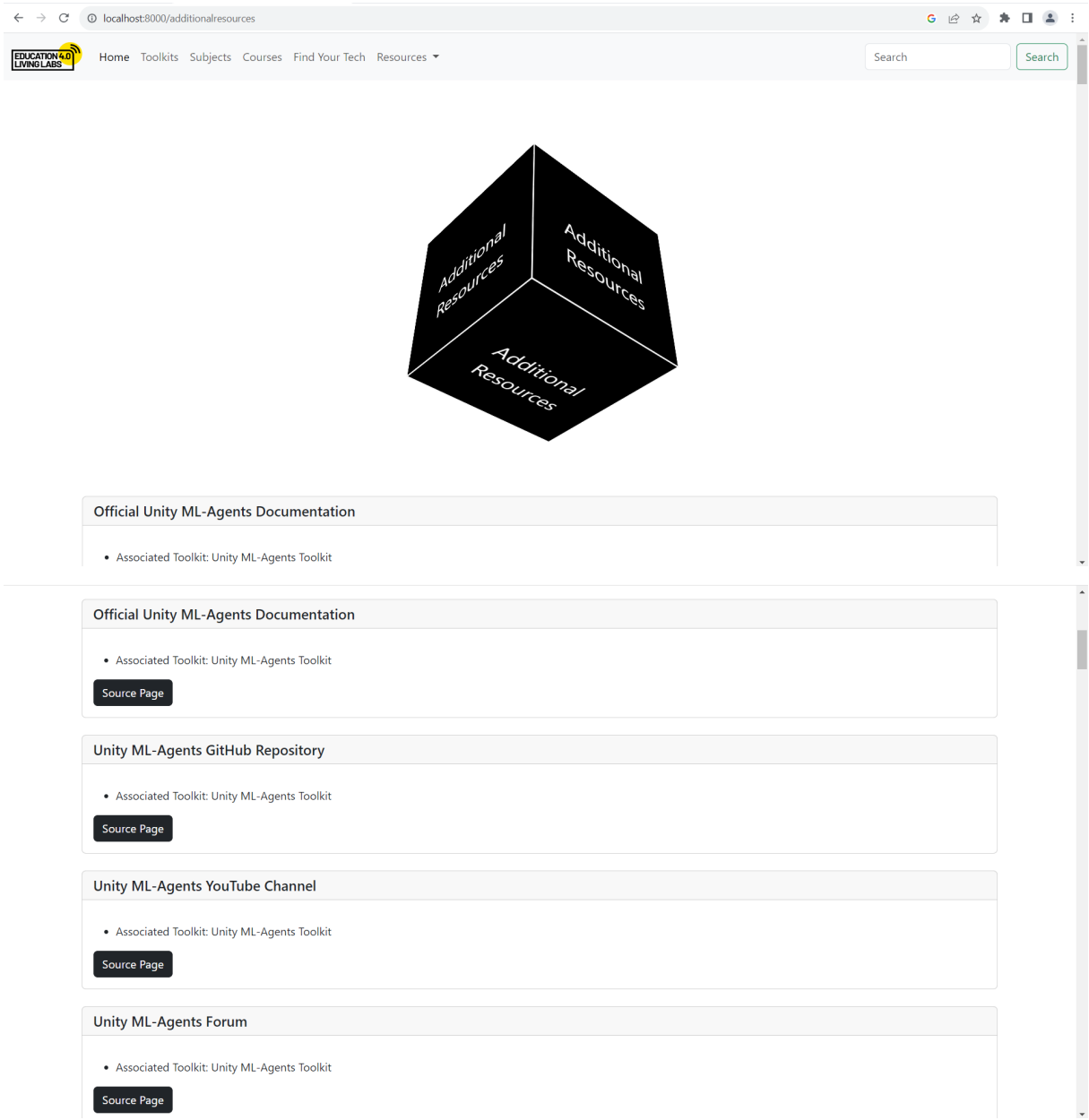
Additionally, by including details about downloadable items and sensors/hardware components, users can gain deeper insights into the practical aspects of each toolkit. This information empowers users to select toolkits that match their requirements and provides a more holistic view of the available resources.



The "Additional Resources" page is a comprehensive directory of all the associated resources available for the toolkits. This page serves as a valuable reference for users, allowing them to

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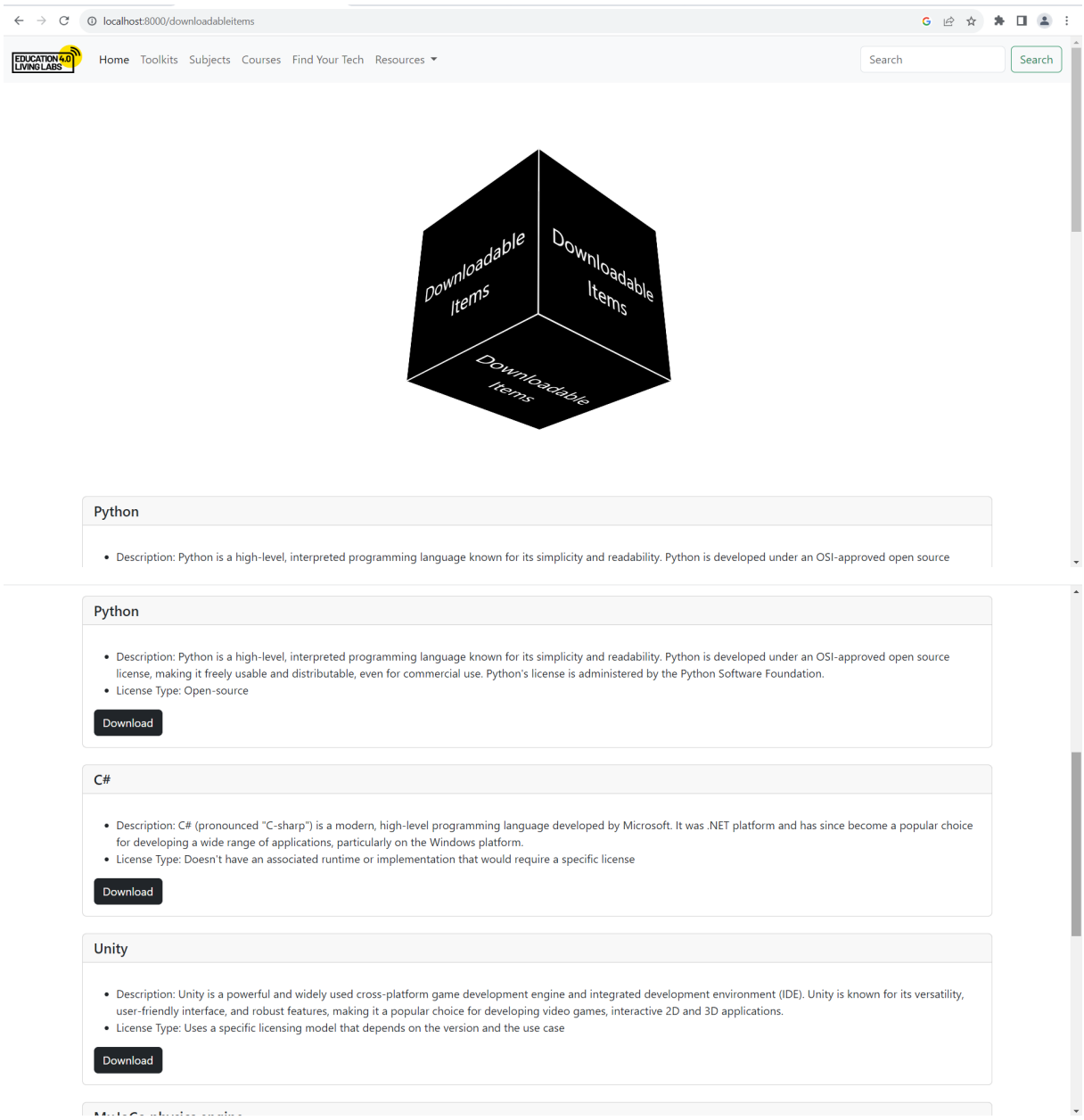
access the official sources and pages associated with each resource through the "Source Page" button. It streamlines the process of exploring and accessing the additional resources linked to the toolkits.



The "Downloadable Items" page is designed to assist users in easily accessing the requirements for specific toolkits. This page offers downloadable Integrated Development Environments (IDEs) and associated items that are essential for working with certain toolkits.

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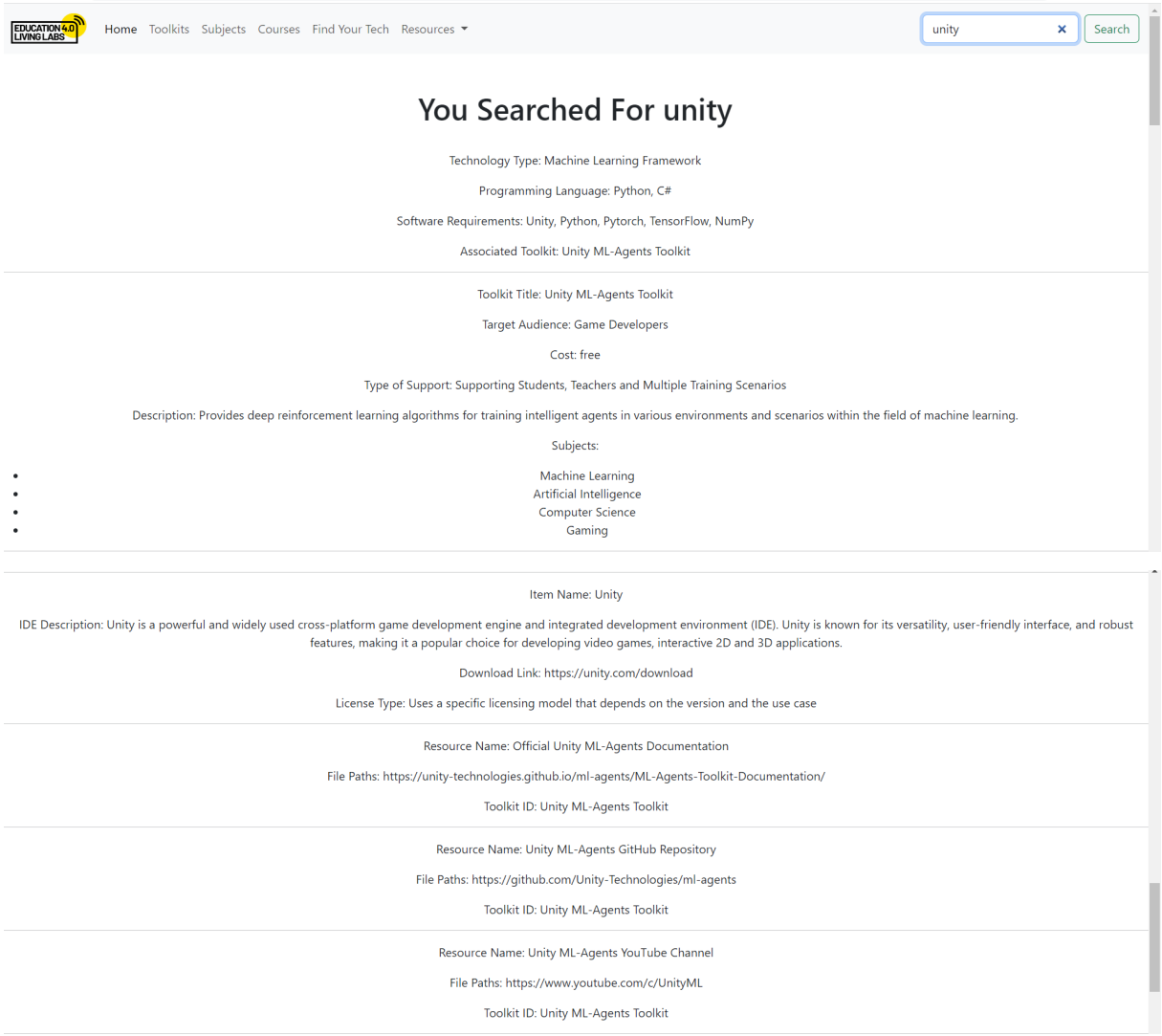
By providing these downloads, the process for users to acquire the necessary software tools and resources it was streamlined.



When you enter a search term, such as "unity," into the search bar, the platform will direct you to a dedicated search results page. This page will display all the relevant information and interfaces that contain the specified word, letter, or sentence. The search functionality is designed to help you quickly find and access the content you are looking for.

The search results page is designed to be user-friendly and provides a comprehensive overview of all the content related to your search query. This allows you to quickly locate the information you need, making it a valuable tool for efficient navigation and content discovery in the platform.

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- 4.2. Working Principle

The user interface (UI) for the Django web application is typically launched and interacted with through a series of steps. Here's a more detailed explanation of how the UI works and how users can access it:

1. *Command Prompt Setup*: To interact with the Django application's UI, users need a command prompt, such as GitBash, or a terminal, depending on their operating system. This command prompt allows them to execute commands and manage the application.
2. *Change Working Directory*: Users should navigate to the directory where the Django project is located. They can do this using the cd (change directory) command in the command prompt. For example, if the project is located in a directory named "mywebsite_project2," they would use a command like cd mywebsite_project2 to set the working directory.
3. *Create a virtual environment*:

```
python -m venv venvsource venv/bin/activate# On Windows, use 'venv\Scripts\activate'
```

Install project dependencies:

```
pip install -r requirements.txt
```

Configure the database (if applicable):

```
python manage.py migrate
```

4. *Start Django Server*: To run the Django application locally, users need to start the Django development server. They can do this by executing the following command in the command prompt:

```
python manage.py runserver
```


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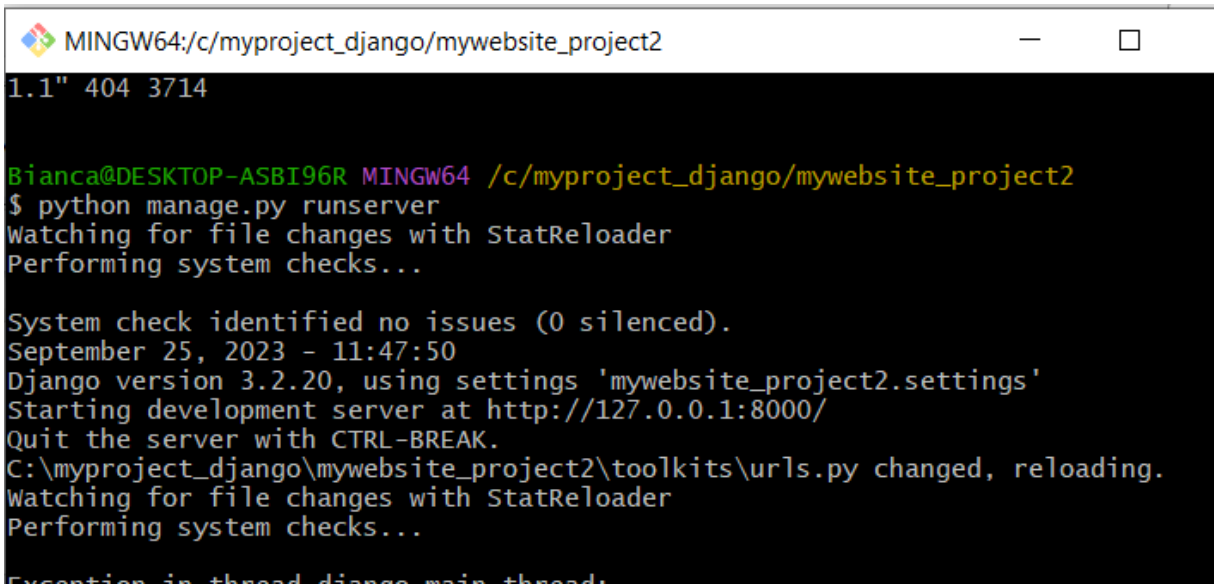

- This command tells Django to launch a local development server that serves the web application. Users will see output indicating that the server is running, and it will specify the local address (usually http://127.0.0.1:8000/).
- *Access the Interface*: With the Django server running, users can open a web browser and navigate to the specified local address. In most cases, they can simply open a web browser and type http://127.0.0.1:8000/ into the address bar to access the UI. This will take them to the home page of the Django application.
- *Interact with the UI*: Once on the home page, users can navigate the interface using the navigation menu, search bar, and other interactive elements. They can explore the content, search for specific information, access toolkits, subjects, courses, resources, and downloadable items, and interact with different sections of the UI.

Accessing the web interface via http://localhost:8000/ and the admin panel via http://localhost:8000/admin are essential aspects of managing and interacting with the Django application. Let's break down these two URLs and their functionalities:

1. http://localhost:8000/
   - When users access the root URL http://localhost:8000/, they will be directed to the main interface of the Django web application.

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- This is the public-facing part of the application that allows users to view content, search for information, and interact with various features you've implemented.

2. http://localhost:8000/admin
   - Accessing the URL http://localhost:8000/admin takes users to the Django admin panel's login page.
3.
   - Superusers can log in using their credentials (e.g., username and password).

Note: The superuser 'user' has the password 'usernova' for this admin login.

Once logged in, superusers can perform various administrative tasks, including:

Adding new records or entries to the database (e.g., adding new toolkits, subjects, courses, resources).

- Modifying existing records or entries (e.g., updating toolkit information).
- Deleting records when necessary (e.g., removing outdated or irrelevant data).
- Managing user accounts and permissions.
- Configuring application settings.

The Django admin panel is a powerful tool that simplifies the process of managing the application's data and settings. Superusers can use this panel to keep the application up to date and ensure it operates smoothly.

The instructions regarding the admin login for the superuser 'user' and the password 'usernova' are important for superuser access to the admin panel. Superusers can log in and perform administrative tasks as needed.

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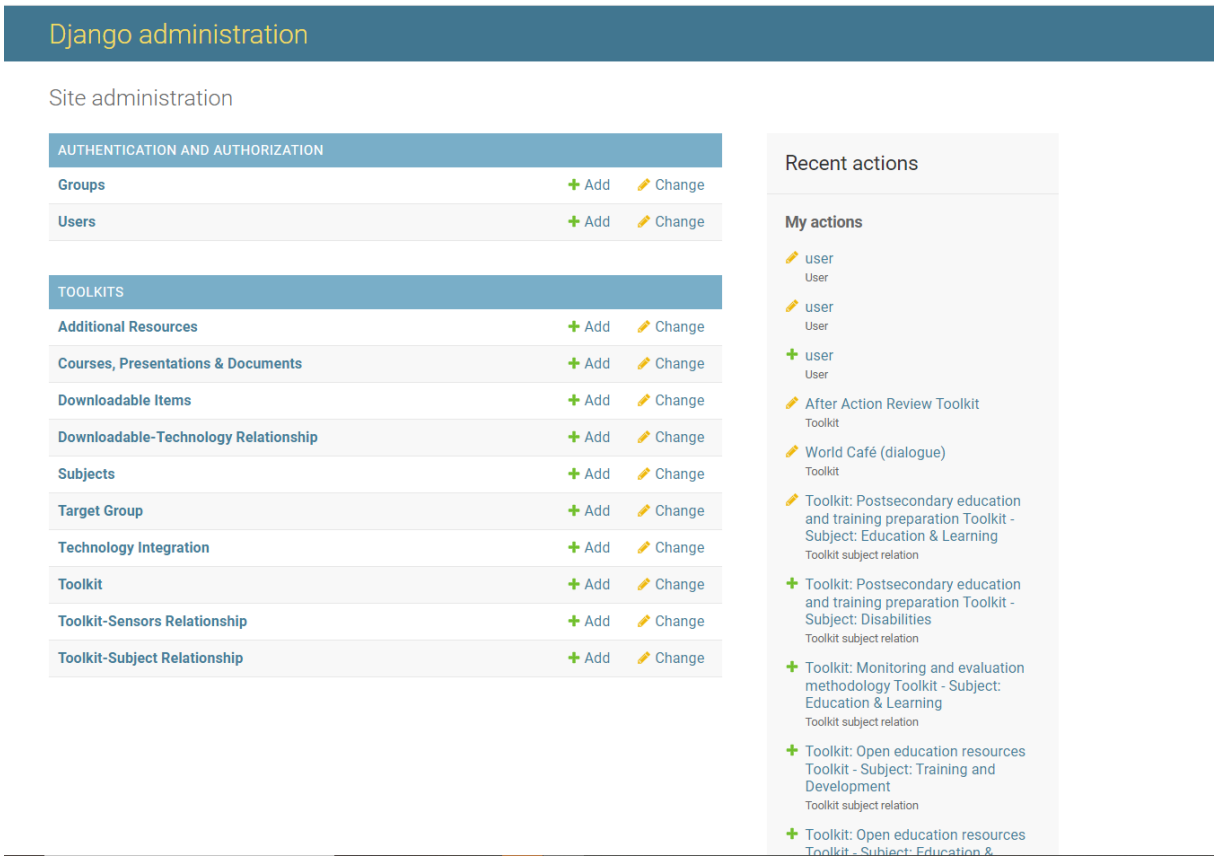

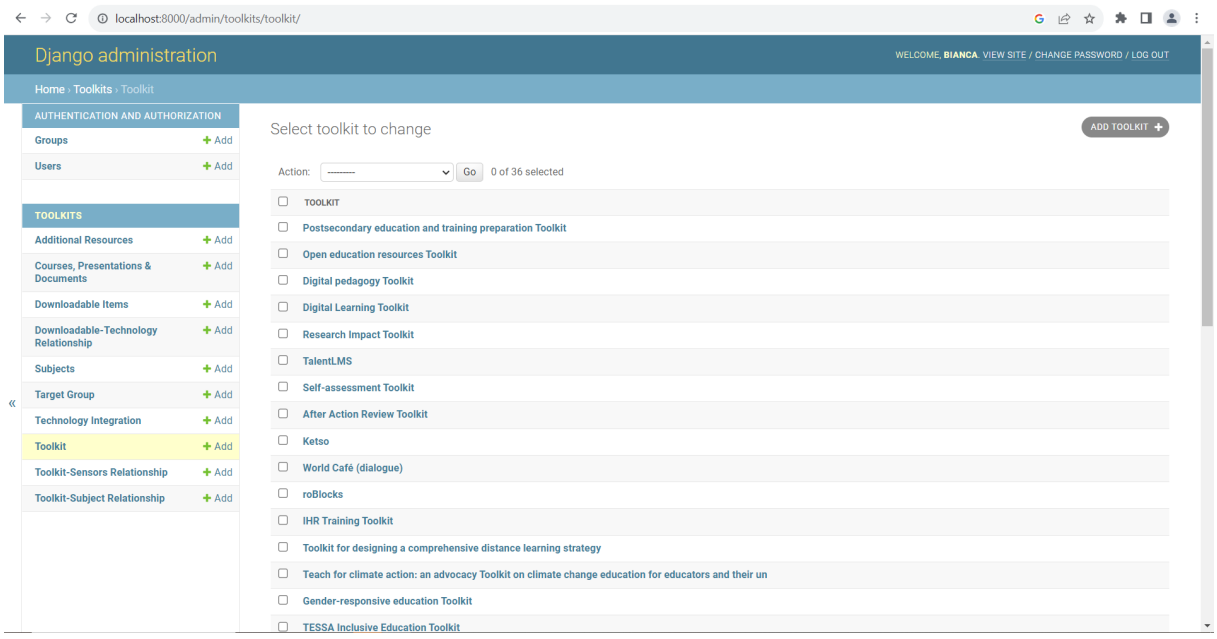

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