Surrounded by Science

Learning Paths towards Science Proficiency

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Deliverable 3.3

First release of the infrastructure and the Science Chaser app

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Legal Notices

Executive Summary

This deliverable describes the first release of the infrastructure and the Science Chaser app. Together with the Digital Toolbox Manager, they constitute the Digital Toolbox of the Surrounded by Science project.

The Digital Toolbox consists of three components: (a) the Science Chaser with which the participants will interact during iSTEM activities, (b) the Digital Toolbox Manager, in which project members can enter information about iSTEM activities and view or download collected data, and (c) the Science Booster which provides organisations with information about the impact of their activities and which provides them with targeted feedback to improve their activities. The first release focuses on the Science Chaser and the Digital Toolbox Manager. The Science Booster will be developed later in the project.

The web framework that is chosen for the creation of the Science Chaser and the Digital Toolbox Manager is Angular. The Science Chaser will be implemented as a progressive web application in order to give it the user experience of a native mobile app. The backend will be created with NestJS running on Node.js. A plugin architecture will be used to display and let participants interact with the iSTEM activities provided by the science organisations. Some Go-Lab apps are made accessible using the plugin architecture. The Digital Toolbox is deployed using Docker containers.

This document accompanies the first release of the Digital Toolbox, which was scheduled for September 2022. This first release provides the team with a version of the Digital Toolbox that can be used for the initial pilot and is a good basis for further development. The current deliverable provides a short overview of the features that will be developed and added to the Digital Toolbox in the coming year. The current document will be updated if the updates make this necessary. In addition, two short manuals have been created to give project members insight into the functionalities of the Science Chaser and the Digital Toolbox Manager. The manuals have been added to this deliverable as appendices. The documentation for creating a plugin has been added as the third appendix.

In order to get access to the Digital Toolbox, you can contact the project coordinator Tessa Eysink (t.h.s.eysink@utwente.nl).

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1 Introduction

This deliverable describes the first release of the infrastructure and the Science Chaser, which are part of the Digital Toolbox. It is an implementation of the conceptual design and key features of the Digital Toolbox, which have been described in D3.1 (Conceptual Design of the Science Chaser app).

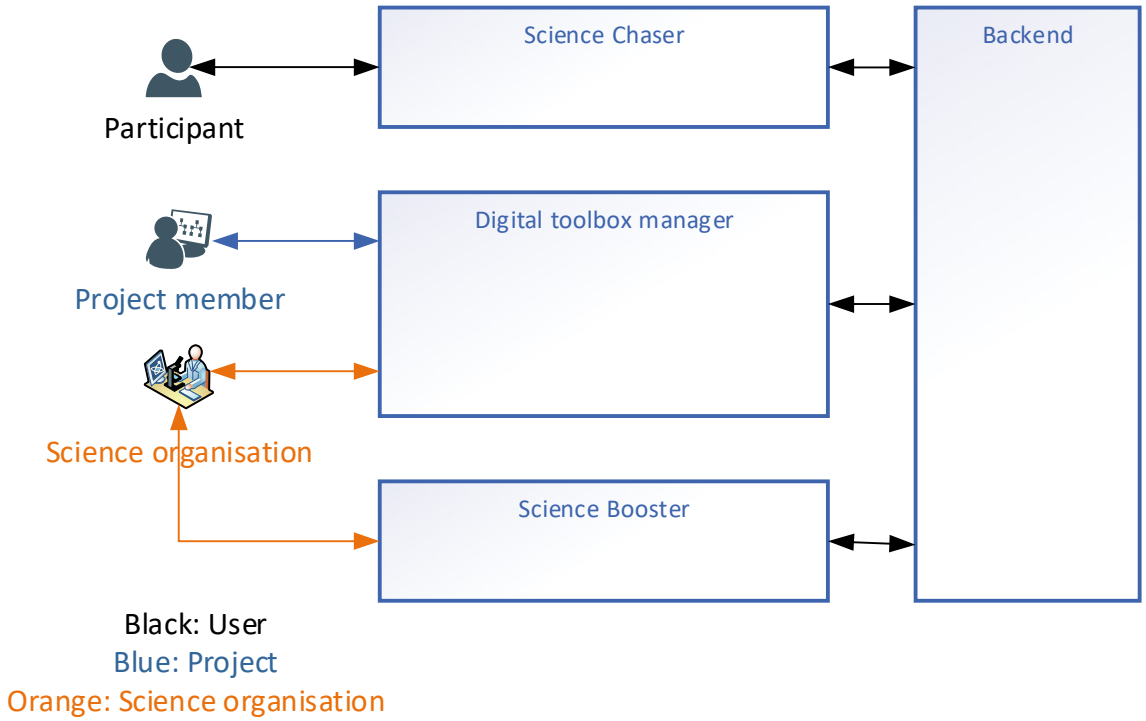
The deliverable starts with a short overview of the Digital Toolbox in Chapter 2. Chapter 3 describes the choices made for the frontend and backend platforms and frameworks. Specific architecture and implementation choices for the backend are described in Chapter 4 and those for the frontend are described in Chapter 5. The plugin architecture and implementation allowing the participants to interact with the artefacts are described in Chapter 6. Chapter 7 describes how the Digital Toolbox is deployed, followed by the conclusions and outlook in Chapter 8. Chapter 9 explains how readers can get access to the Digital Toolbox. Finally, the user manuals for the Science Chaser and the Digital Toolbox Manager and the documentation of creating a plugin are attached as appendices.

As the development of the Digital Toolbox goes on, parts of this deliverable may get superseded. This especially applies to the user manuals and plugin documentation appendices, attached to this deliverable. Hence, the project will keep these up to date as separate documents.

2 Digital Toolbox

The Digital Toolbox is the central software of the project. It is described in detail in D3.1 (Conceptual Design of the Science Chaser app). A short overview of the Digital Toolbox components is shown in Figure 1 (copied from section 5.1 in D3.1).

Figure 1. *Overview of the Digital Toolbox*



The Science Chaser is the component with which the participants will interact. The participants will use the Science Chaser on their mobile devices. The Science Chaser will let the participants interact with the iSTEM activities of science organisations. And it will track how the participants use the iSTEM activities.

The Digital Toolbox Manager will be used by the project members. The project members will enter information about the iSTEM activities and view or download collected data on how the participants interacted with the iSTEM activities.

The Science Booster will provide the participating iSTEM organisations with information about the impact of their activities and will provide them with targeted feedback to improve these. The Science Booster will be developed in the last year of the project. Thus, it will not be discussed in this deliverable.

3 Platform and framework choices

There are several platforms and frameworks available for implementing the Digital Toolbox. The choices for the frontend (Digital Toolbox Manager, Science Chaser, and Science Booster) and the backend can be made independent of each other. Practically each frontend platform and framework combination can work together with all backend combinations of platforms and frameworks. In this chapter, the choices that have been made will be discussed.

The largest part of the Digital Toolbox will be implemented by a small team of (two) developers of the University of Twente. The same persons will have to work on the frontend and the backend. Choosing similar backend and frontend platforms and frameworks will make the development of the Digital Toolbox easier.

3.1 Frontend

A project requirement is that the Science Chaser runs on mobile devices of the participants. This means that the Science Chaser has to run on a wide range of Android and iOS mobile phones. Although participants will be familiar with running apps found in the Apple AppStore and Google Play Store, the downside is that two different apps have to be developed, one for iOS and one for Android and that the iOS app has to be approved by Apple and the Android app by Google (and all updates also have to be approved). All this approving will take time and effort.

There are frameworks available which makes writing apps for Android and iOS easier. They do this by making it possible to write one app which can run as a native Android and iOS app. The drawback, however, is that one still needs to write some specific code for Android and iOS.

A good alternative is to create a progressive web application (PWA, https://en.wikipedia.org/wiki/Progressive_web_application). A PWA can behave like a native app on mobile devices (and as apps on laptops and desktops). It is a web application running inside a web browser, but it is using a similar user experience (UX) as a native mobile application. As the foreseen functionality of the Science Chaser can be achieved in a PWA, it will be our development choice.

Most modern web frameworks (frameworks aimed at creating web applications) have support for creating a PWA. Angular is one of the most popular web frameworks, developed and maintained by Google. Angular is an opiniated framework, which means that it has a well-defined way for implementing most of the common (and not so common) web features. It also offers great tooling support for the development. Using Angular for creating the Science Chaser matches well with the experiences of the Twente developer team. The Science Chaser will be made with Angular and following this, the Digital Toolbox Manager (and most likely the Science Booster) will also be made with Angular.

3.2 Backend

Currently, the most popular backend platform is Node.js (https://nodejs.org). Node.js is basically the V8 JavaScript engine (used in Chromium based browsers such as Google Chrome and Microsoft Edge), running directly on the operating system itself, without the browser view. All the developer tooling available for JavaScript in the browser can also be used for JavaScript in Node.js. Choosing a Node.js based framework allows for sharing code, tooling, and experiences between the frontend and the backend development.

One of the fastest-growing Node.js frameworks for building efficient, scalable backend applications using Node.js is NestJS (https://nestjs.com). NestJS works in a similar way as

Angular. Using NestJS matches well with the experiences of the Twente developer team. The backend will thus be made using NestJS.

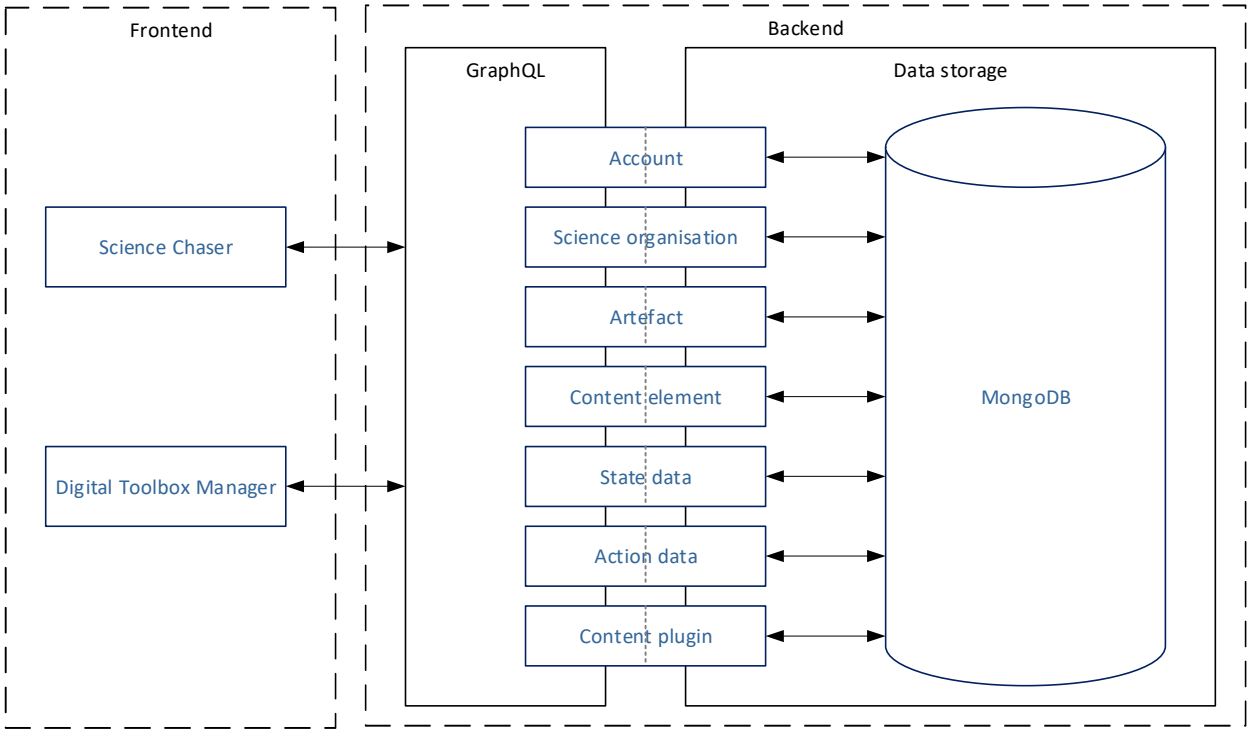
4 Backend

The backend is organised in a number of components, one for each data type described in section 5.3 of D3.1 (Conceptual Design of the Science Chaser app). A subset of the components are currently implemented. The remaining components will be added in the future. The implemented components are:

- Accounts
- Science organisations
- Artefacts
- Content elements
- State data
- Action data
- Content plugin

Each component is divided in two parts: one part handling the data manipulation and another part handling the call from the frontend. Figure 2 shows a schematic overview of the backend architecture and its relation to the frontend.

Figure 2. *Architecture of backend.*



The data will be stored in MongoDB (https://www.mongodb.com), the most popular NoSQL database. Using a NoSQL database will allow for very flexible data storage and access. The database will only be accessed in the data manipulation part of the data components.

Besides the data components, there are two additional pieces of code: the common code and the authentication code. The common code handles the common data manipulation, and the authentication code handles the user authentication (including two factor authentication) and authorisation.

For the communication with the frontend, GraphQL will be used. GraphQL allows for flexible access to the data, without the need to create separate endpoints for every type of access.

5 Frontend

5.1 Digital Toolbox Manager

The purpose of the Digital Toolbox Manager is that project members can enter and edit information about the artefacts of science organisations, which then is shown to the participants in the Science Chaser. In addition, the Digital Toolbox Manager allows researchers to look at and download collected data about the participants. The initial users of the Digital Toolbox Manager are the project members, later on it might also be used by members of science organisations outside the project. The Digital Toolbox Manager will mostly be used on desktop and laptop computers. The Digital Toolbox Manager will therefore be a normal web application, the additional effort of making it a PWA is not needed.

The Digital Toolbox Manager will use modern security measurements, including two factor authentication. Project members can only edit artefacts and content elements of their own science organisation. Artefacts and content elements of other science organisations can only be viewed. Project members and science organisations can only be added by the administrators. All the edit operations are logged, including those of the administrators.

The user manual of the Digital Toolbox Manager is attached to this deliverable as Appendix I. The user manual is a living document and will be kept up to date with the further development of the Digital Toolbox Manager.

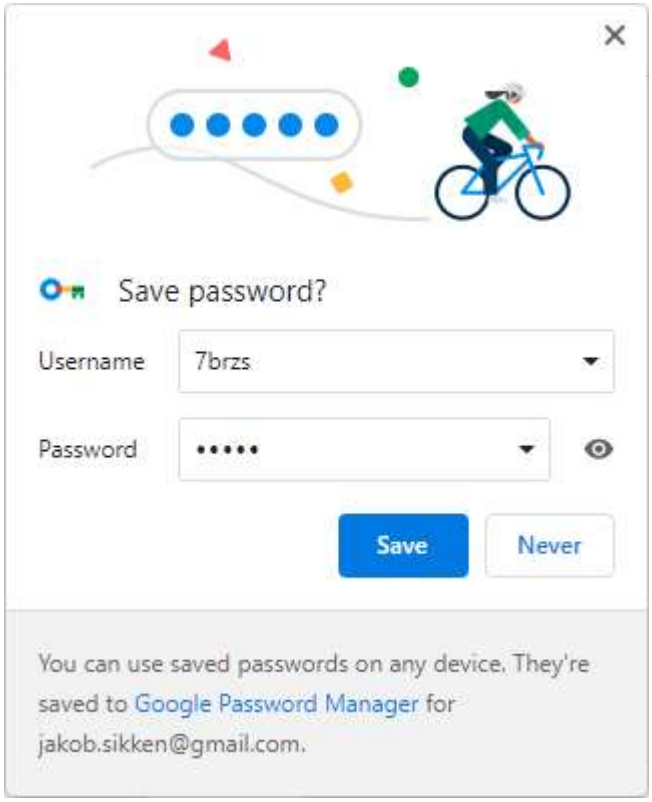
5.2 Science Chaser

As the Science Chaser will be used on mobile devices, it is important that it is easy to use and that it has an attractive design. The first release of the Science Chaser is mainly aimed at achieving the basic functionality and ease of use.

The participants will have to register before they can use the Science Chaser. As the project wants to keep the participants anonymous, we have to prevent that the participants can enter identifiable information (such as real names and email addresses). This is achieved by assigning them a login name. In addition, the participants have to choose a password themselves. This procedure is described in section 5.1 of D1.2 (Data management plan) and section 5.2.4 of D3.1 (Conceptual Design of the Science Chaser app).

As the Science Chaser is a web application and browsers can save login name/password combinations, we can help our participants in remembering their assigned login name and self-chosen password. During the registration process, the browser will be triggered to ask the participant whether the assigned login name and self-chosen password combination should be saved. Figure 3 shows the save password question of Google Chrome.

Figure 3. *Save password dialog of Google Chrome*



There is always a trade-off between ease of use and security; more security means less ease of use. This is also the case for two factor authentication. In our case, a participant can only access his or her own entry and not the entries of other participants. Furthermore, in line with privacy first design, no identifiable data (or combination of data that makes the participant identifiable) will be collected. We therefore decide not to use two factor authentication for the Science Chaser.

The user manual of the Science Chaser is attached as Appendix II to this deliverable. The user manual is a living document and will be kept up to date with the further development of the Science Chaser. This user manual is meant for the project members. Later on, the project might decide to make some short videos about how to use the Science Chaser for the participants, as this is common for apps.

5.3 Shared code

The Science Chaser and the Digital Toolbox Manager are both web applications and access the same backend. As a result, there is a lot of functionality that is needed in both web applications (e.g., retrieving and updating the same objects from the backend and the use of plugins). This functionality is implemented in a shared code library, which is used by the Science Chaser and the Digital Toolbox Manager.

6 Plugins

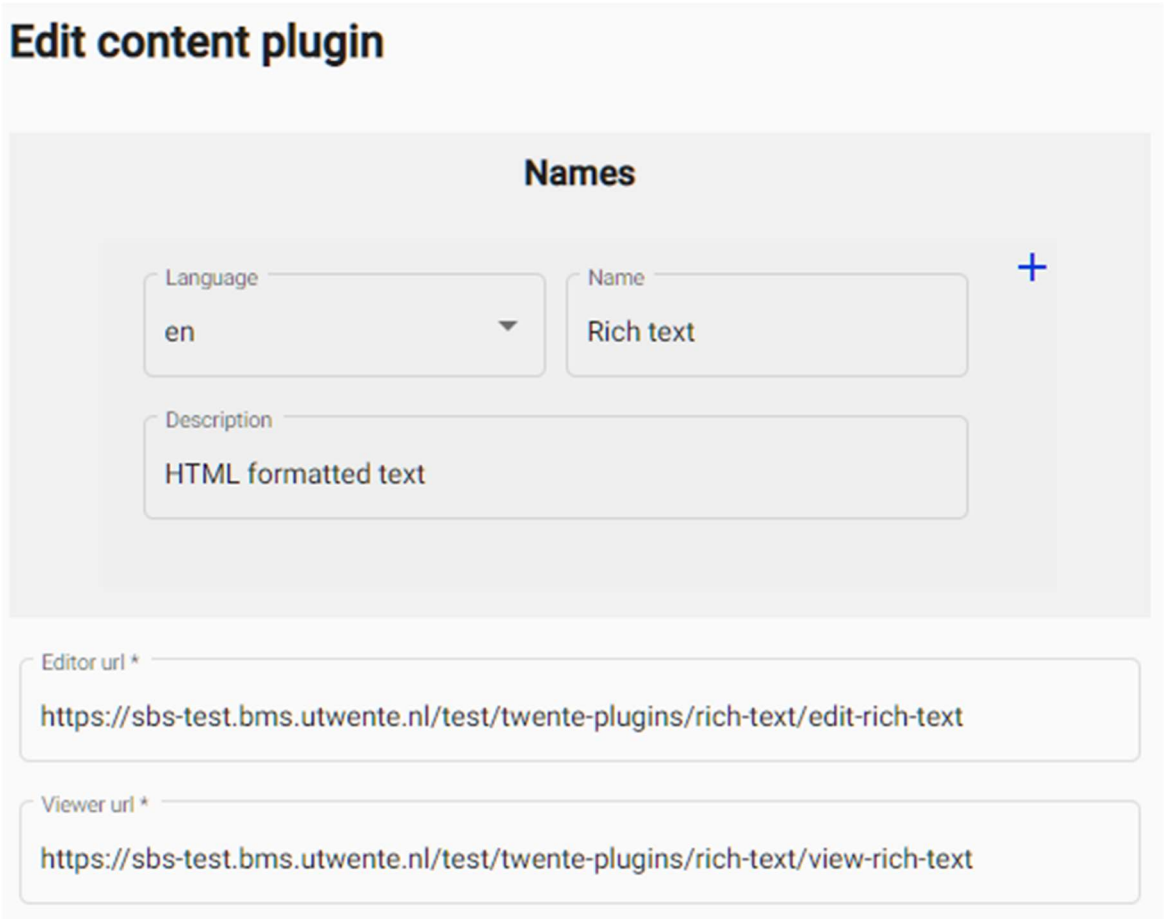
6.1 Plugin interface

The participants can interact with an artefact through its content elements. For each type of content element, there is a separate content plugin. By using plugins, the Digital Toolbox Manager and the Science Chaser can easily be extended with new types of content elements. The plugins will be loaded separately by the Digital Toolbox Manager and the Science Chaser. This way, content plugins can be added and updated without changes to the Digital Toolbox Manager and the Science Chaser. This will also make it easy for other project partners (and in the future third parties) to create their own content element types.

For each content element type, two different plugins are needed, one for the editing of the content (in the Digital Toolbox Manager) and one for interacting with the participant (in the Science Chaser). Both plugin interfaces are similar, making it easy to combine both plugin types in one piece of code.

A plugin can be defined in the Digital Toolbox Manager by administrators. A screen dump of the edit content plugin is shown in Figure 4.

Figure 4. *Screen dump of edit content plugin*



The documentation on how to implement a plugin is attached as Appendix III to this deliverable.

6.2 Available plugins

At the time of writing this deliverable a few plugins are available. The rich text editor is the only custom plugin, all others are Go-Lab apps (https://www.golabz.eu). Additional plugins will be created in the future, like an image upload and viewer.

6.2.1 Rich text

The rich text editor plugin is an WYSIWYG editor (https://en.wikipedia.org/wiki/WYSIWYG). It uses the open source summernote (https://summernote.org) text editor. The offered set of edit options might be changed in the future. A screen dump of the rich text editor is shown in Figure 5 and Figure 6 shows the accompanying screen dump of the rich text viewer.

Figure 5. *Screen dump of rich text editor*

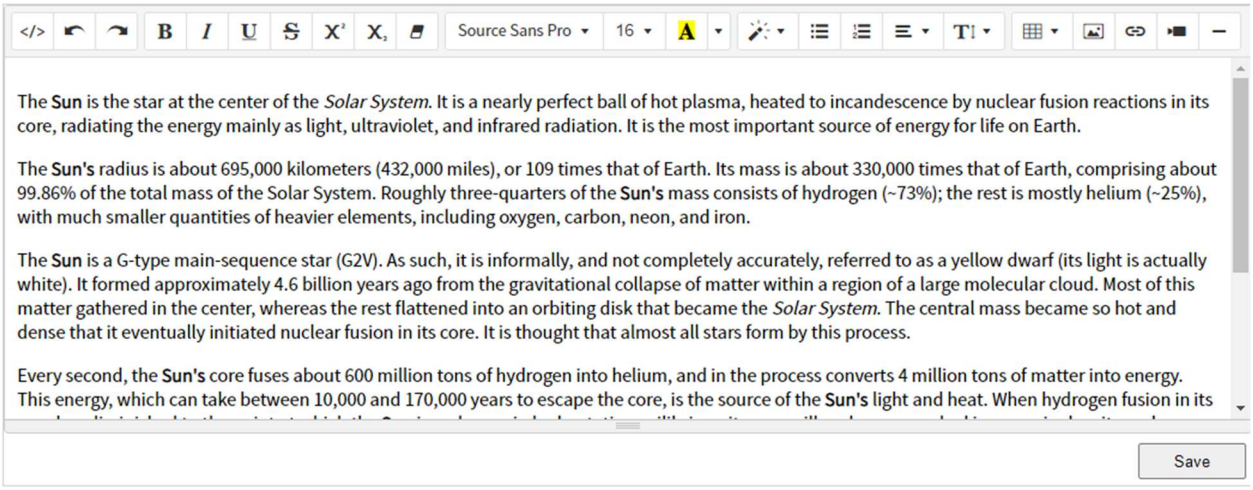
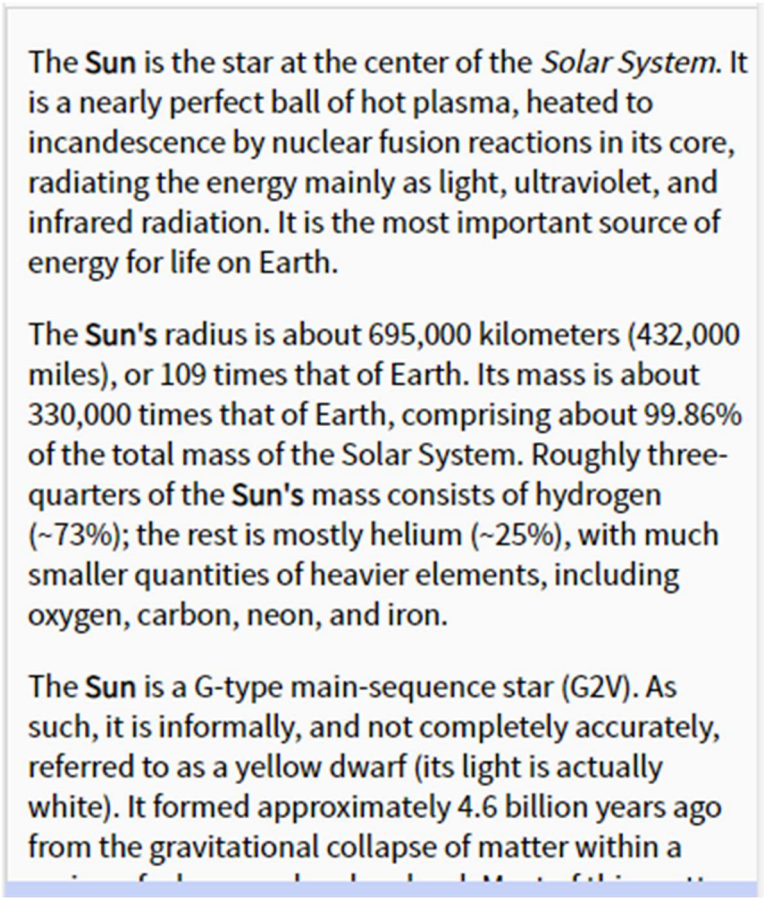


Figure 6. *Screen dump of rich text viewer*


The **Sun** is the star at the center of the *Solar System*. It is a nearly perfect ball of hot plasma, heated to incandescence by nuclear fusion reactions in its core, radiating the energy mainly as light, ultraviolet, and infrared radiation. It is the most important source of energy for life on Earth.

The **Sun's** radius is about 695,000 kilometers (432,000 miles), or 109 times that of Earth. Its mass is about 330,000 times that of Earth, comprising about 99.86% of the total mass of the Solar System. Roughly three-quarters of the **Sun's** mass consists of hydrogen (~73%); the rest is mostly helium (~25%), with much smaller quantities of heavier elements, including oxygen, carbon, neon, and iron.

The **Sun** is a G-type main-sequence star (G2V). As such, it is informally, and not completely accurately, referred to as a yellow dwarf (its light is actually white). It formed approximately 4.6 billion years ago from the gravitational collapse of matter within a

6.2.2 Go-Lab apps

A wrapper plugin has been created, which allows a subset of the Twente Go-Lab apps (https://www.golabz.eu/apps) to be used. The Twente Go-Lab apps have been created in the EU funded Go-Lab project (https://premium.golabz.eu/about/projects/go-lab-project) and Next-Lab project (https://nextlab.golabz.eu/). The aim of the apps is to support the online learning. We will only use Go-Lab apps that do not rely on results of other apps.

Based on the requirements of WP4 (Research Implementation) and WP5 (Impact Assessment), a preliminary selection is made for the apps to be used. The selection can easily be changed.

6.2.2.1 Name the frame

In the Name the frame app, an image (e.g., a screenshot of a lab, a diagram with different components, a graph, etc.) is shown to the participant. The app allows participants to drag and drop labels into frames. By doing so, participants can label or name different parts of the image.

In the Digital Toolbox Manager, users can upload an image, add the labels, and specify the locations of the corresponding frames. Users can also, optionally, add details (description or question) to these labels.

After the participants have moved all the labels to the frames (in the Science Chaser) and checked whether the labels are in the correct frames, they will be able to view the additional information or answer the questions, if these are configured. A screen dump of the Name the frame editor is shown in Figure 7; Figure 8 shows the accompanying screen dump of the Name the frame viewer.

Figure 7. *Screen dump of the Name the frame editor.*

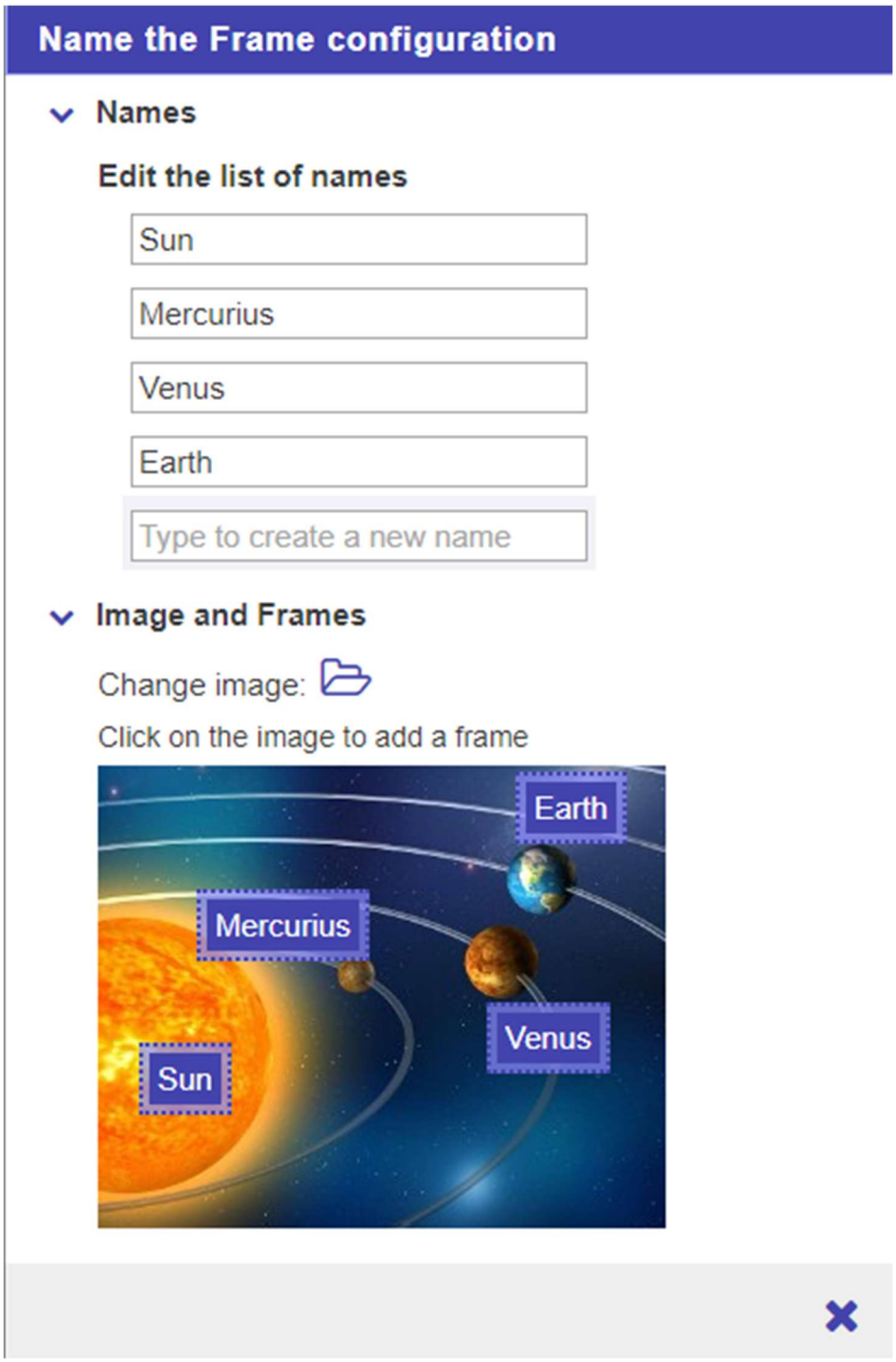
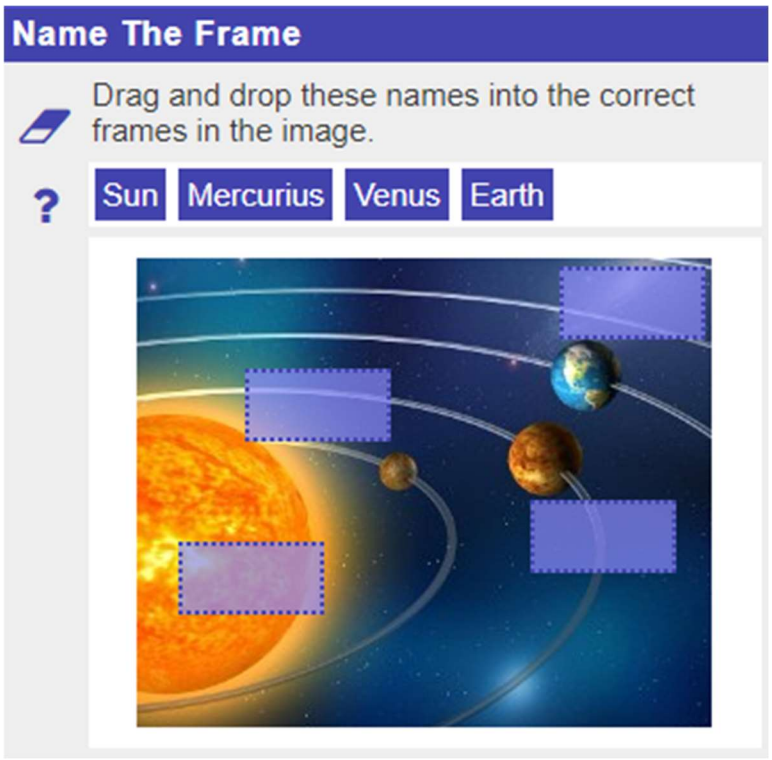


Figure 8. *Screen dump of the Name the frame viewer.*



6.2.2.2 Quiz

Through the Quiz app participants can answer different type of questions. These questions can be in the form of multiple choice, multiple select, open answer, numerical answers, and two-way (this or that) questions. For most question types, the answers can be selected from a predefined list and feedback can be provided based on the selected correct or incorrect answer.

In the Digital Toolbox Manager, users can create the questions and specify the correct answers and feedback.

6.2.2.3 Questionnaire

The Questionnaire app allows participants to complete questionnaires and surveys by answering multiple choice, multiple select, open answer and table like questions with multiple choice, multiple select, and smileys type answers.

In the Digital Toolbox Manager, users can create the questions for the questionnaire or survey. A screen dump of the Questionnaire editor is shown in Figure 9 and Figure 10 shows the accompanying screen dump of the Questionnaire viewer.

Figure 9. *Screen dump of the Questionnaire editor.*

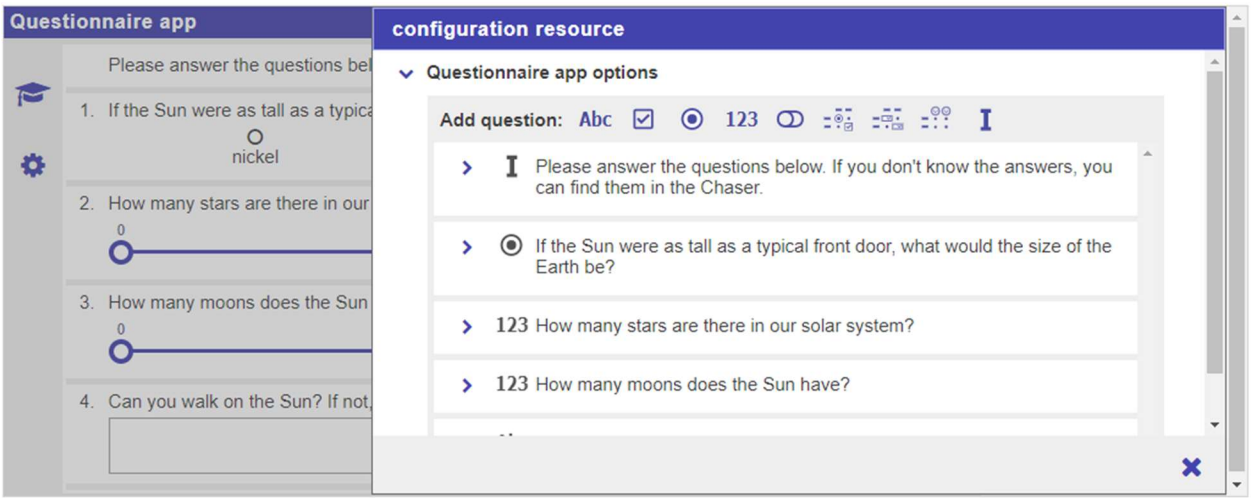
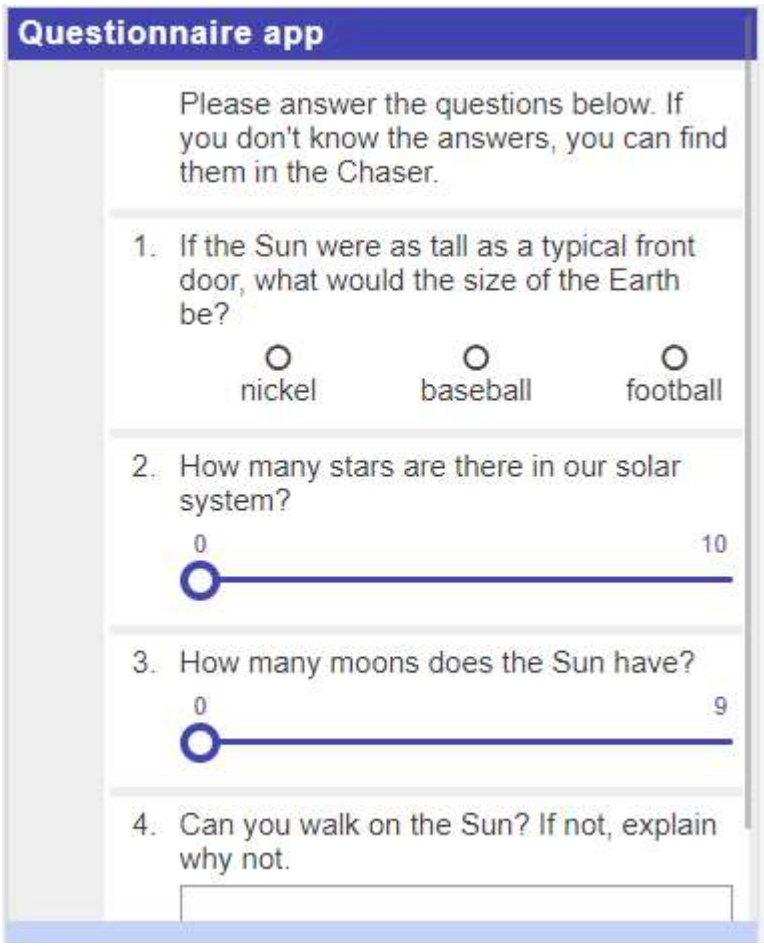


Figure 10. *Screen dump of the Questionnaire viewer.*



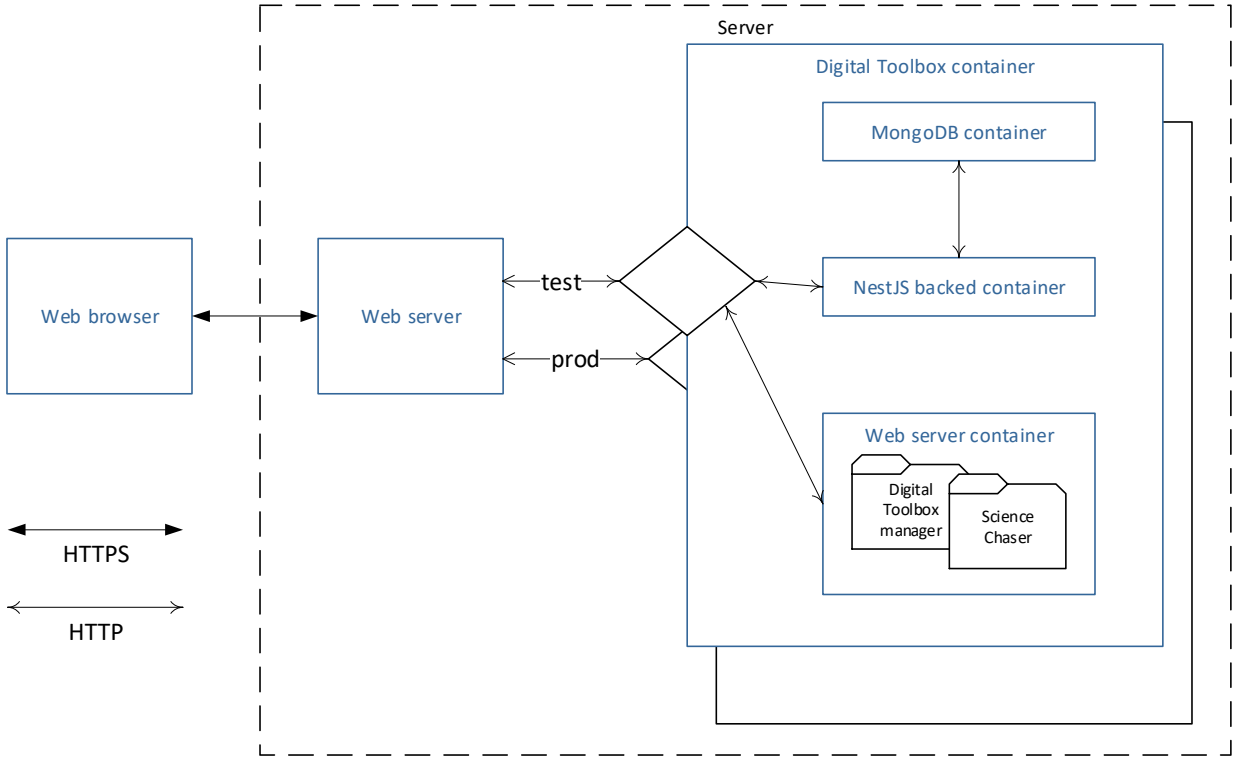
6.2.2.4 Video player

The video player app can show a video to the participants or let the participants select a video from a list. In the Digital Toolbox Manager, users can specify one or more videos.

7 Deployment

The Digital Toolbox is deployed using Docker containers (https://www.docker.com). The main container has three sub containers: one for MongoDB, one for the NestJS backend and one with a web server hosting the frontend apps. Multiple Digital Toolboxes can run on the same host server. On the host server a web server runs, which handles the HTTPS encryption and forwards the request to the correct Digital Toolbox container. A overview of the Digital Toolbox deployment is shown in Figure 11.

Figure 11. *Overview of deployment Digital Toolbox.*



The Digital Toolbox source code is stored on GitHub, code changes to the master branch are only applied after passing all tests. After a successful code change on the master branch, the new code is automatically deployed on the test server.

All stored data is encrypted, to make the data unusable if unauthorized persons get hold of it.

8 Conclusions and outlook

This deliverable describes the first release of the infrastructure and the Science Chaser, as part of the Digital Toolbox. All essential functionality for the initial pilot with the Digital Toolbox is present.

The current state of the Digital Toolbox provides a good basis for future developments as well as the implementation of the remaining features that are described in D3.1 (Conceptual Design of the Science Chaser app). Below, we provide a short overview of key features that will be implemented in the coming year:

1. An easy and attractive UX for the Science Chaser
2. Gamification elements in the Science Chaser
3. Experiments, as described in section 5.2.11 of D3.1
4. Interactive/research elements, as described in section 5.3.4 of D3.1
5. Artefact routes, as described in section 5.2.3 of D3.1
6. Export of collected data
7. More plugins, like uploading and viewing of images and PDF files

With respect to point 1, developing an easy and attractive UX for the Science Chaser, this will be done by creating mock-ups and discussing them first in WP3 and later in the entire project and with potential users. Adjustments will be made based on suggestions of project members and the experiences of the users. These steps are described in section 7.2 of D3.1 and were planned to be done before September 2022. Due to staffing problems at NTNU, these steps had to be postponed and are now planned for November 2022.

The user manuals of the Science Chaser and Digital Toolbox Manager are meant for the project members. We are considering to combine both user manuals into one; this way project members can get a better idea of how actions in the Digital Toolbox Manager change the content of the Science Chaser. If needed, we will create some short videos explaining the Science Chaser to the participants.

9 Access information

The Digital Toolbox is still in development and at the time of writing this deliverable, it is only accessible for project members. If readers want to have access to the Digital Toolbox, please contact the project coordinator Tessa Eysink (t.h.s.eysink@utwente.nl).

10 List of appendices

Appendix I Digital Toolbox Manager user manual

Appendix II Science Chaser user manual

Appendix III Content plugin documentation

Appendix I

Digital Toolbox Manager user manual

Surrounded by Science

Learning Paths towards Science Proficiency

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Appendix I

User Manual of the Digital Toolbox Manager

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User Manual of the Digital Toolbox Manager

This appendix is a user manual for the Digital Toolbox Manager (abbreviated to DTM), intended to be used by project members, and it is supposed to answer questions which might arise when using the DTM.

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1 General information

The Digital Toolbox Manager is used by the project members to add and edit information to the Surrounded by Science project. The project members add information about the science organisations that they belong to, which is in turn visible in the Science Chaser. The different functionalities available to the Digital Toolbox Manager are explained in the sections below.

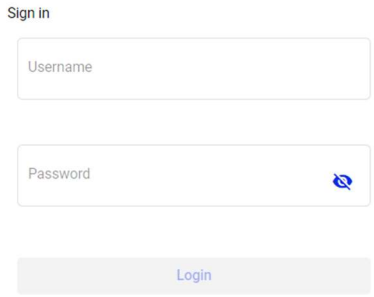
2 Access to the software

The Digital Toolbox is still in development and at the time of writing this user manual, it is only accessible for the project members and reviewers. In order to get access to the Digital Toolbox, please contact the project coordinator Tessa Eysink (t.h.s.eysink@utwente.nl).

2.1 How to login

In order to access the app, the members of the science organisation need to log into the app. Members of the science organisations are given login name and password combinations by the technical team at the UT.

Figure 1. *Login*



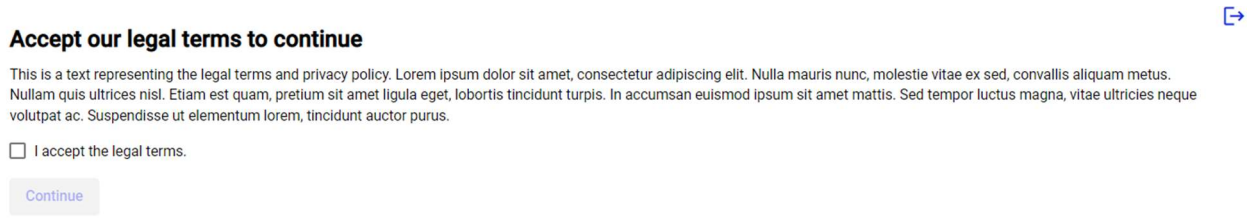
2.2 First time login

To unlock the app, first time users have to complete a number of steps as part of their initial login procedure.

2.2.1 Legal terms

The first screen presented to users upon logging into the app, is a screen explaining the legal terms of Surrounded By Science. After accepting these terms, users can continue to the next step, and if not, users can stop using the app. (Note that the text for the legal terms is not ready yet)

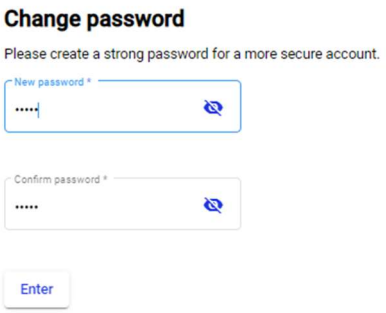
Figure 2. *Accept legal terms*



2.2.2 Change password

Users need to change their password into something more secure. At this point, users should change their password and go to the next screen.

Figure 3. *Change password*



2.2.3 Enabling two Factor Authentication

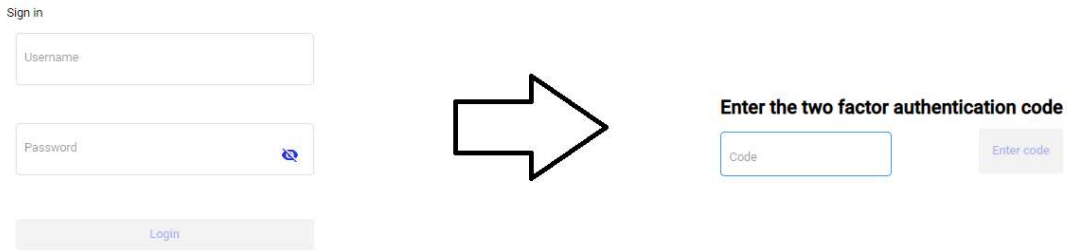
To increase security, the DTM requires users to enable two factor authentication before proceeding to use the app. Users must click the Generate QR button to generate a QR code, and then they must use an Authenticator app such as the Google Authenticator to scan the QR code, via their mobile phones. The mobile phone will periodically generate a 6 digit code to be used in the DTM, for access. When users provide the 6 digit code in their authenticator app, the two factor authentication is enabled.

Figure 4. *The two steps to enable two factor authentication*

2.3 Logging into the app

After completing the steps of the first time login, users can login to the app. They use their login name and password to go to the two factor authentication screen, provide their two factor authentication code from their authenticator app and log into the app.

Figure 5. *Login to the app after going through the first steps*



2.4 Lost password

In case the user of the DTM loses their password, they can contact the technical team at the University of Twente for help.

3 Main features of the Digital Toolbox Manager

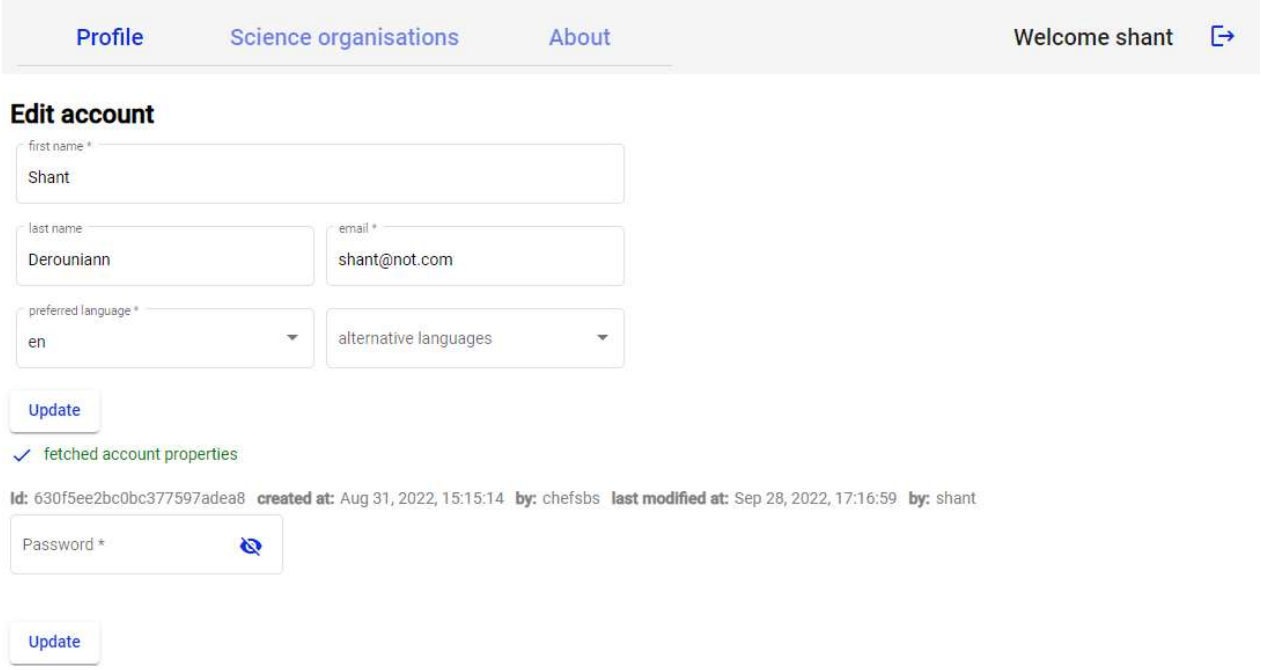
3.1 About Module

When the users login to the DTM, they see a welcome message, and are taken to the about module. This module has a link to the Surrounded by Science website, and shows some technical information about the application.

3.2 Profile Module

In the profile module, users of the DTM have the possibility to change their personal information, such as their first name, last name, and email. Most notably, users can also change their preferred language and provide alternative languages. The preferred language is the language that the DTM will use, alternative languages are languages that users also understand. When users are viewing the DTM in their preferred language, and some content is not available in that specific language, alternative languages can be used to show that content.

Figure 6. *Profile module*



3.3 Science Organisations Module

Through the science organisations module, users of the DTM can add and edit the details of the science organisation they belong to.

3.3.1 General information

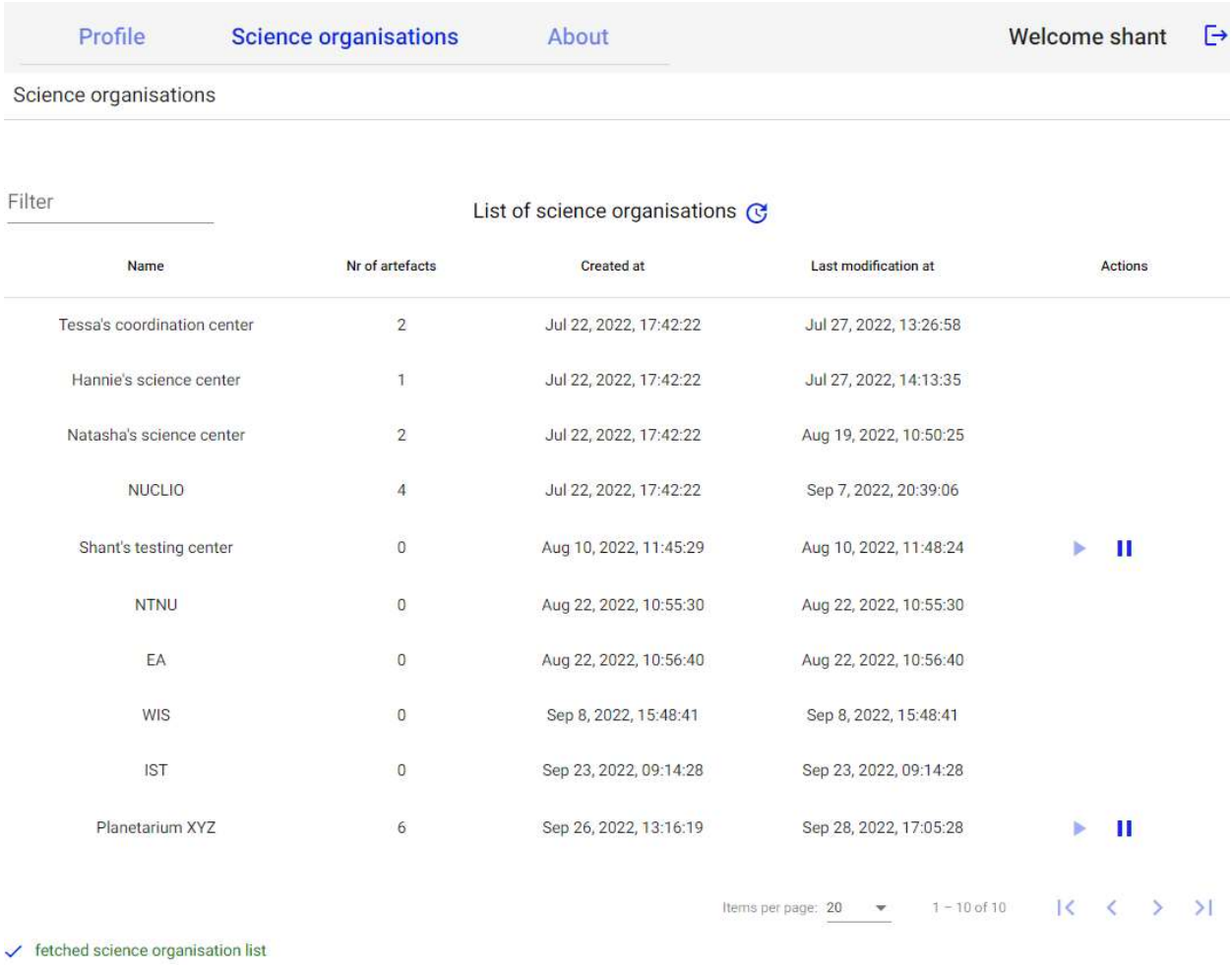
User accounts are created by the technical team at the University of Twente. The technical team will assign users to the science organisation that they belong to. Users are able to view every science organisation and their details. However, users are only allowed to edit information about the science organisation they belong to. Users are allowed to edit artefacts and content elements belonging to the science organisation they are associated with. More

information about Artefacts and Content elements is given in their respective sections. Users with rights to change information from a particular organisation can also disable and enable entities. Disabled entities will not appear in the Science Chaser anymore, they are in a hidden state, and will reappear when the entity is enabled again. Entities can only be deleted when they are empty and not used. Only administrators can add or delete science organisations.

3.3.2 Science organisations

The science organisations list (see Figure 7 for an example) shows the science organisations in a table. Each science organisation is represented by a row in the table. The row shows some of the details of the science organisation. At the end of each row, there are some actions that can be performed by users that belong to the specific science organisation. For example, users that belong to a science organisation can enable and disable the science organisation by clicking the play/pause icons at the end of each row.

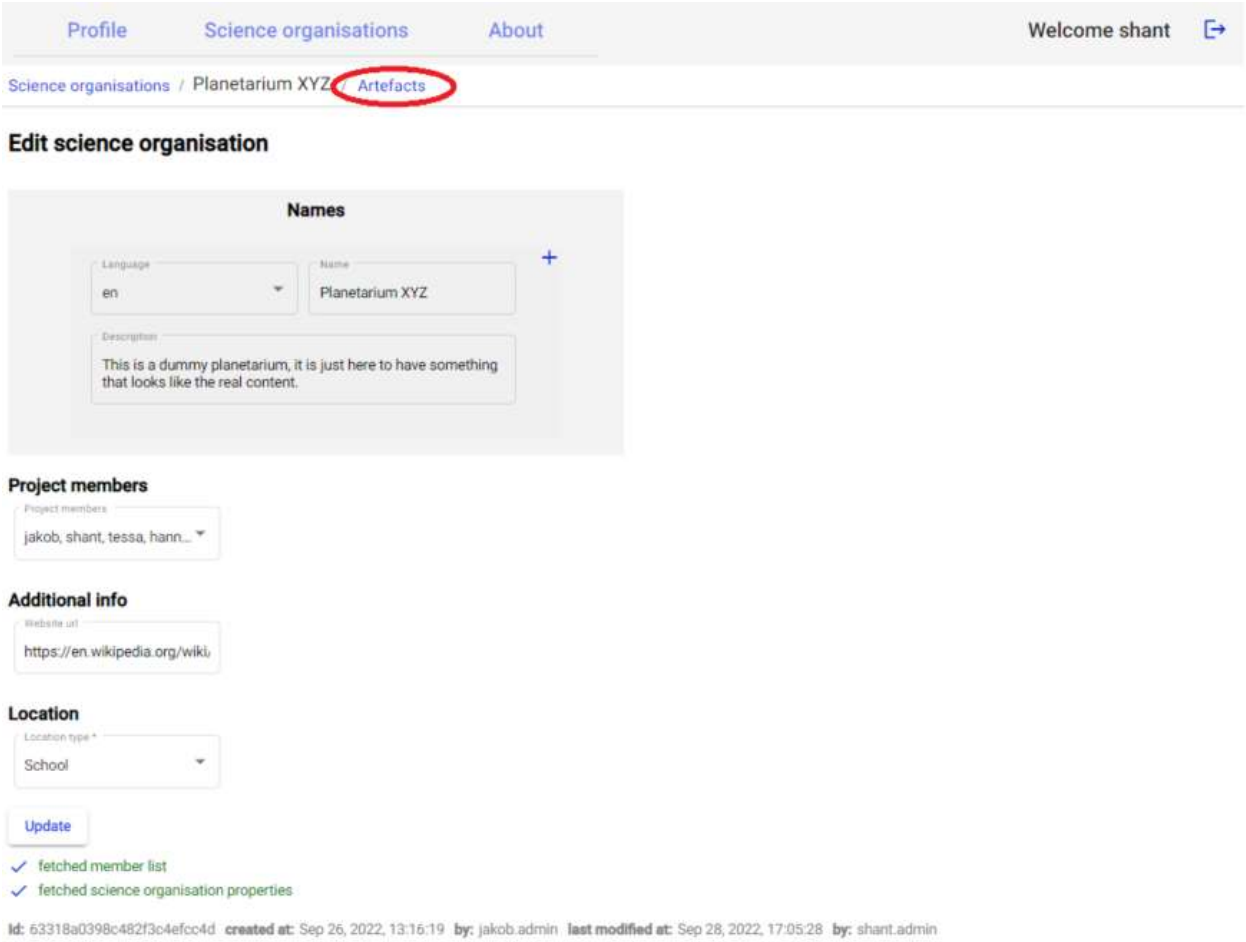
Figure 7. *List of science organisations*



By clicking a row, users can view the details of the science organisation. Users can see the name of the organisation in multiple languages, the URL of the organisations website, the location, and current members of the organisation. If the user is viewing the details of the organisation to which they belong, they also have the rights to edit the details on this page.

Users can go to the artefacts of a given science organisation by clicking the button highlighted in red in Figure 8. The artefacts will be described below.

Figure 8. *Science organisation details*

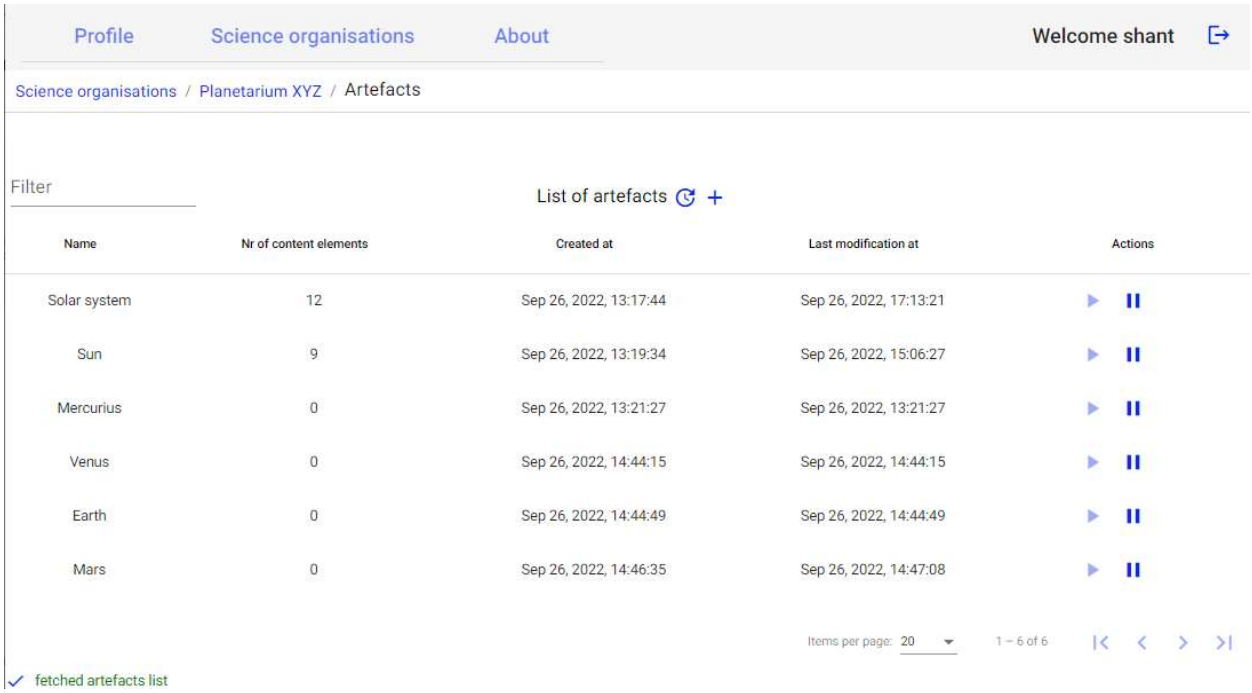


3.3.3 Artefacts

An artefact is the smallest real world entity in a science organisation. An artefact could be, for example, an entity of an exhibit in a museum. See section 5.3.3 of D3.1 for more information about artefacts.

The list of artefacts (see Figure 9 for an example) belonging to a science organisation can be accessed by going to the details of a science organisation, and clicking the “Artefacts” button at the top of the screen, shown in red in Figure 8. Much like the list of science organisations, the table shown here shows the list of artefacts, belonging to a science organisation. Each row represents a single artefact. The actions at the right side of each row represent the enable/disable functionality, which users have access to if the artefacts are associated with a science organisation they belong to.

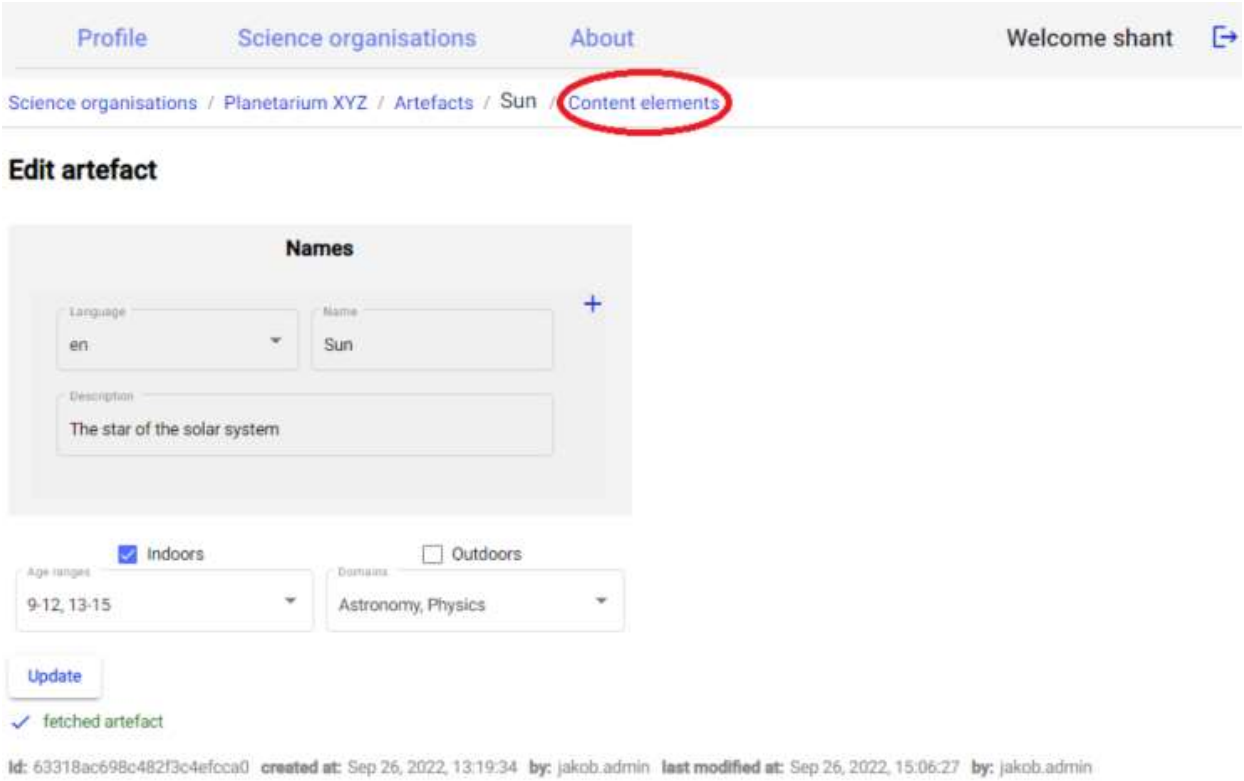
Figure 9. *List of artefacts*



New artefacts can be added to the science organisation that a user belongs to, by clicking the plus button at the top of the screen. Users will be redirected to the create artefact screen, where they must enter the name and description of the artefact in at least one language, followed by some other details which will be described below.

By clicking a row, users can view all the details of the artefact (Figure 10). If users belong to the science organisation, they can edit the details of the artefact as well. On the details screen, users with editing rights can provide different names for the artefact in different languages, specify whether the activity is meant to be performed “Indoors” or “Outdoors”, and change the age ranges and domains of the activity.

Figure 10. *Edit artefacts*



In addition to the details mentioned above, users can go to the content elements of a given artefact, by clicking the button highlighted in red in Figure 10. The content elements will be described below.

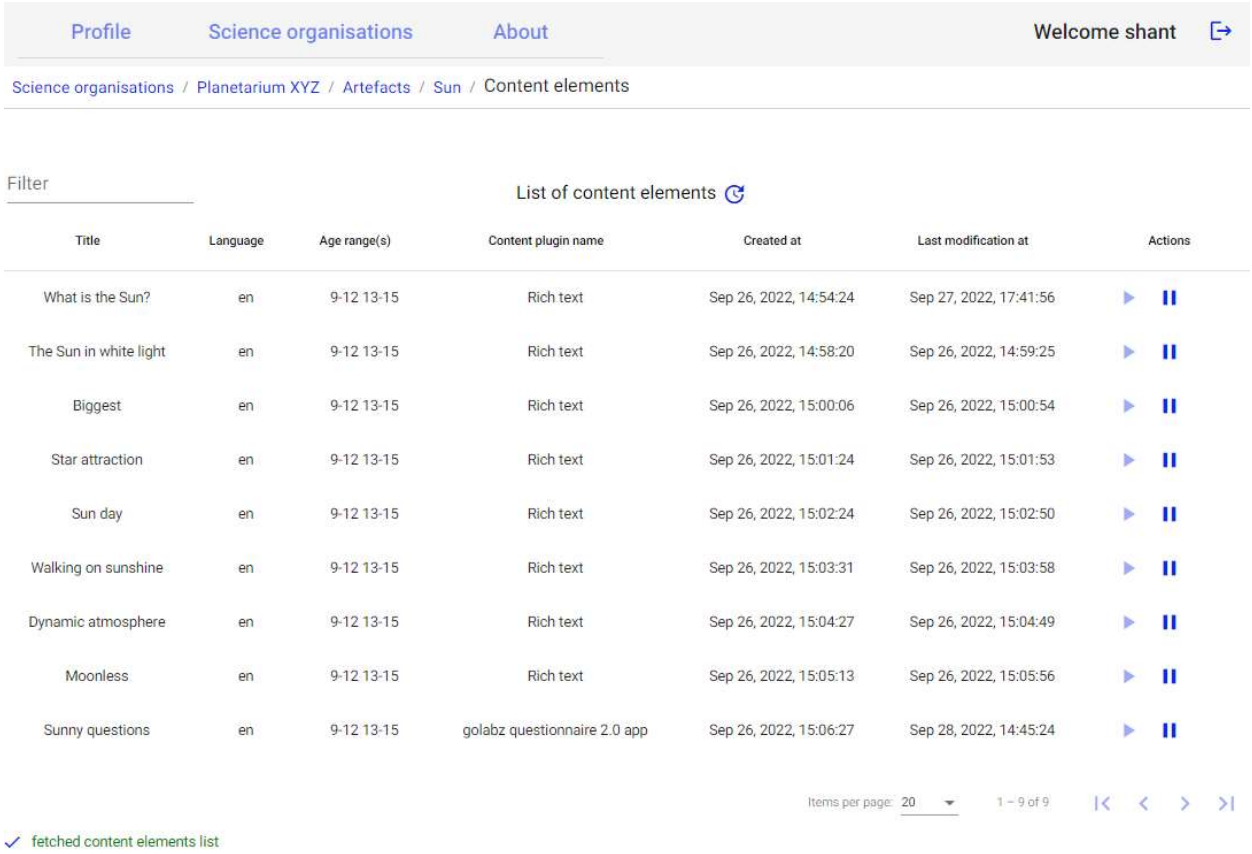
3.3.4 Content Elements

The content elements are multimedia elements attached to a real world artefact. The content elements provide additional information or methods of engagement with an artefact, through the Science Chaser. For example, a content element could be a text with an image giving more details about the artefact at hand, or it could be a game or questionnaire which can be used to give more engagement to the artefact. Therefore the project members can use the Digital Toolbox Manager to add content elements to the artefacts of the science organisation that they belong to. See section 5.3.3 of D3.1 for more information about content elements.

The list of content elements (see Figure 11 for an example) belonging to an artefact can be accessed by going to the details of a science organisation, clicking the “artefacts” button at the top of the screen, going to the details of an artefact, then clicking the “content elements” button at the top of the screen.

The table of content elements shows the list of content elements belonging to an artefact. Each row represents a single content element. The actions at the right side of each row represent the enable / disable functionality, which users have access to if the content elements of an artefact are associated to a science organisation users belong to.

Figure 11. *List of content elements*

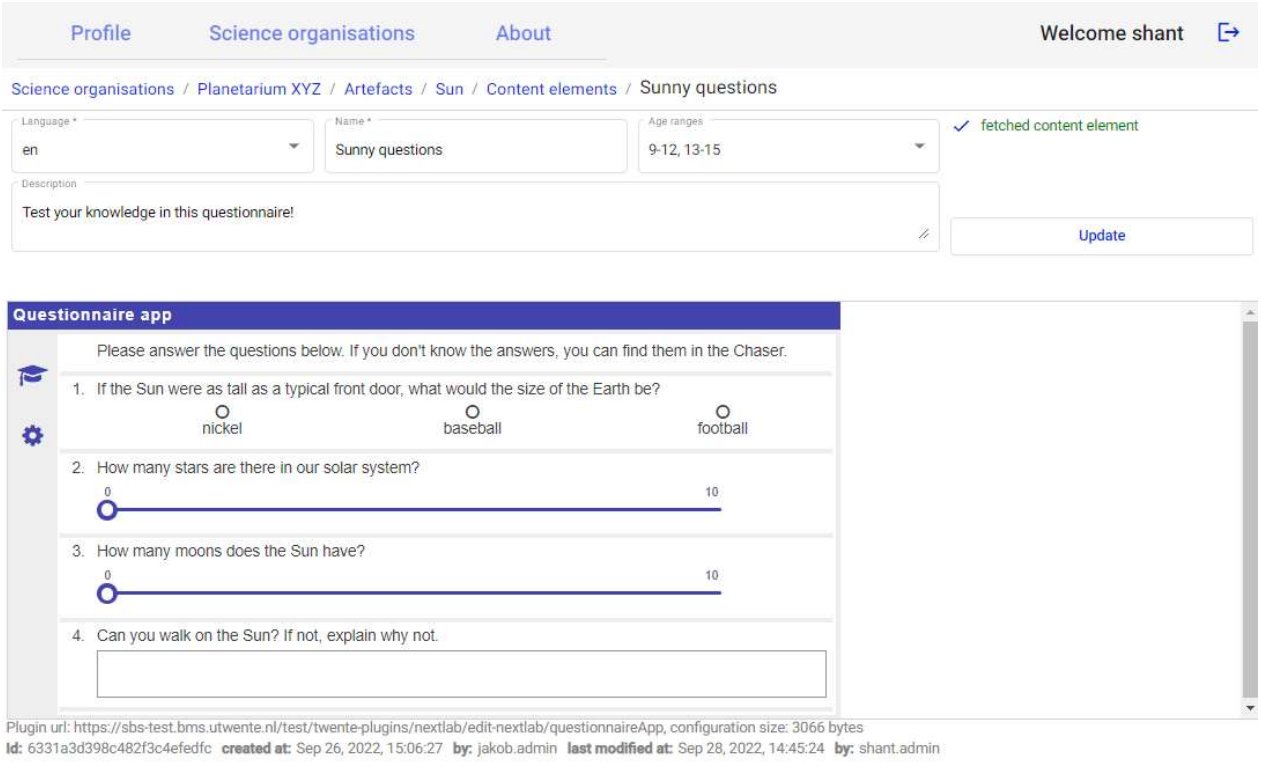


New content elements can be added to an artefact by clicking the plus button at the top of the screen. Users can only add elements to artefacts from their own science organisation. Upon clicking the plus button, users will be redirected to the create content element screen, where they must specify the content plugin to use, the language, name, and age ranges of the content element.

The content elements are language dependent, for every language, a separate content element must be created. The Science Chaser will only show a content element to the participant if its language matches the preferred or alternative languages of the participant. Also, the Science Chaser will only show content elements to a participant if the age range of the content element matches the age range of the participant.

The edit content element screen (Figure 12) is a screen where users can modify the content element attached to an artefact. In this screen, the content element editor allows users to modify the content of the content element, which is to be shown inside the Science Chaser.

Figure 12. *Edit content elements*



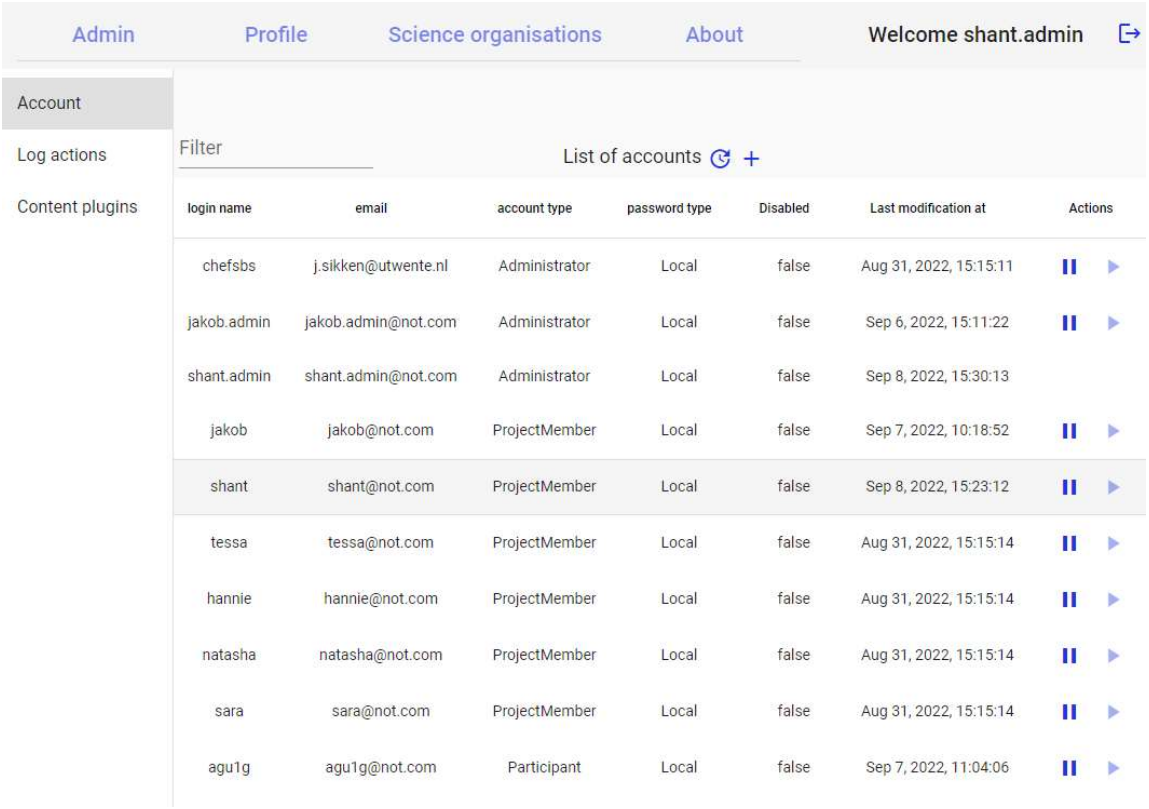
3.4 Admin Module

This section is accessible to administrator users only. Currently only the technical staff at the University of Twente are administrators. The administrators have access to the modules for account management, log action management, and content plugin management.

3.4.1 Accounts

The accounts module (see Figure 13 for an example) is used to manage the accounts for both the Science Chaser and the DTM. The administrators can use this module to create new accounts, to edit account details, and also to enable or disable accounts. Accounts cannot be deleted.

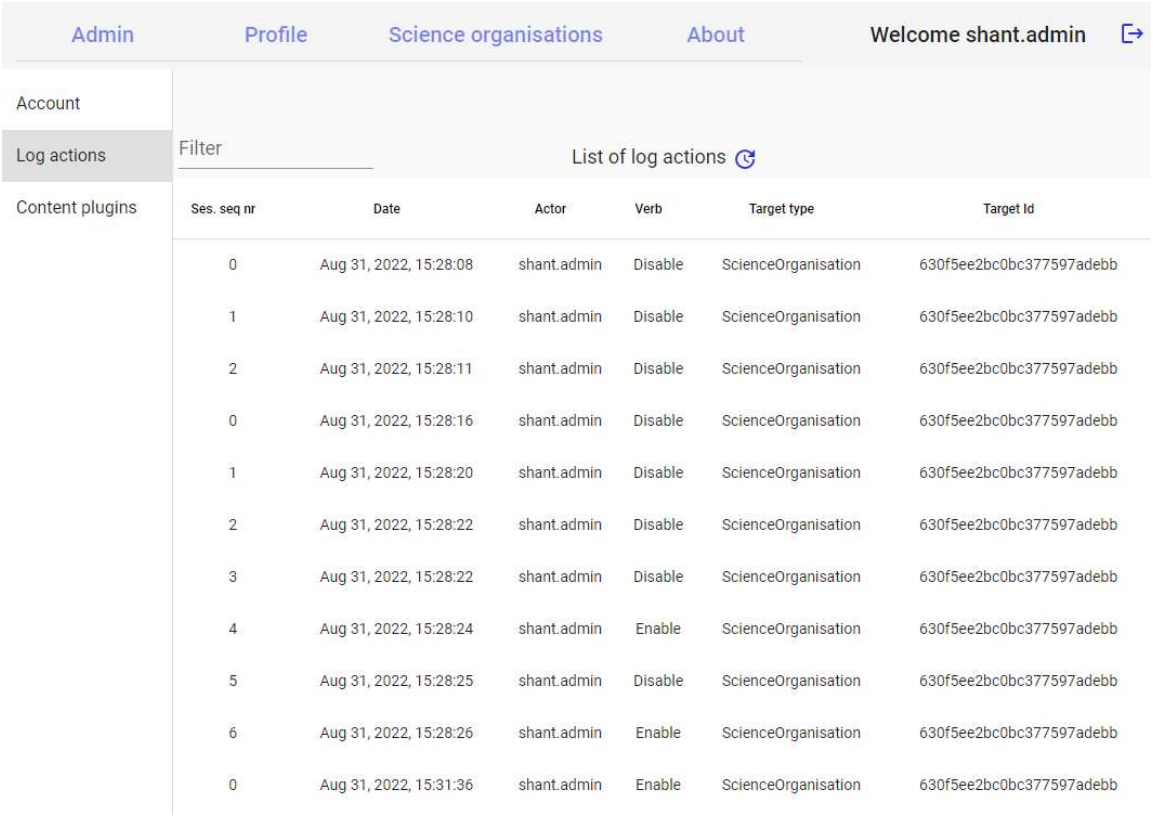
Figure 13. *Accounts*



3.4.2 Log actions

The log actions module (Figure 14) is used to show a list of all log actions. These actions are specific actions which we are tracking, such as logging into the app, creating, editing, deleting, updating, enabling, or disabling entities. These can be used to track the activity inside the app and can be used for auditing purposes.

Figure 14. *Log actions*

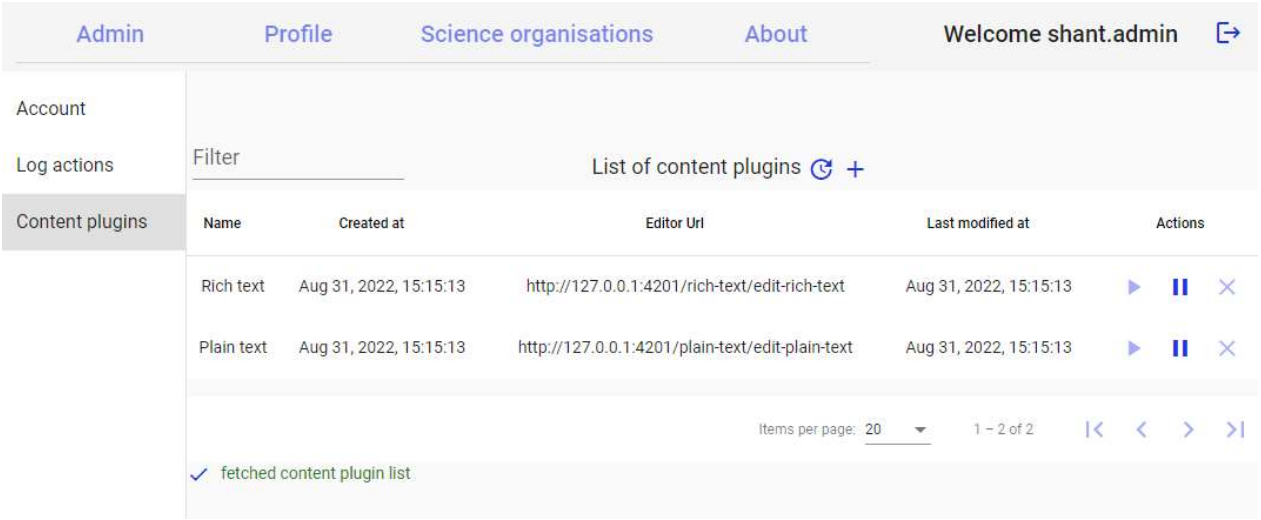


Ses. seq nr	Date	Actor	Verb	Target type	Target Id
0	Aug 31, 2022, 15:28:08	shant.admin	Disable	ScienceOrganisation	630f5ee2bc0bc377597adebb
1	Aug 31, 2022, 15:28:10	shant.admin	Disable	ScienceOrganisation	630f5ee2bc0bc377597adebb
2	Aug 31, 2022, 15:28:11	shant.admin	Disable	ScienceOrganisation	630f5ee2bc0bc377597adebb
0	Aug 31, 2022, 15:28:16	shant.admin	Disable	ScienceOrganisation	630f5ee2bc0bc377597adebb
1	Aug 31, 2022, 15:28:20	shant.admin	Disable	ScienceOrganisation	630f5ee2bc0bc377597adebb
2	Aug 31, 2022, 15:28:22	shant.admin	Disable	ScienceOrganisation	630f5ee2bc0bc377597adebb
3	Aug 31, 2022, 15:28:22	shant.admin	Disable	ScienceOrganisation	630f5ee2bc0bc377597adebb
4	Aug 31, 2022, 15:28:24	shant.admin	Enable	ScienceOrganisation	630f5ee2bc0bc377597adebb
5	Aug 31, 2022, 15:28:25	shant.admin	Disable	ScienceOrganisation	630f5ee2bc0bc377597adebb
6	Aug 31, 2022, 15:28:26	shant.admin	Enable	ScienceOrganisation	630f5ee2bc0bc377597adebb
0	Aug 31, 2022, 15:31:36	shant.admin	Enable	ScienceOrganisation	630f5ee2bc0bc377597adebb

3.4.3 Content plugin management

This module (Figure 15) can be used to manage the content plugins used in the Science Chaser and the DTM. Anytime a new plugin is created, the plugin can be added to the list of content plugins, and it will immediately be available to be used for content elements. The plugins can be developed by the team at the UT, or by any other partner. They need to support an editor and a viewer mode. See Appendix III of D3.3 for more information about content plugins.

Figure 15. *Content plugins*



Name	Created at	Editor Url	Last modified at	Actions
Rich text	Aug 31, 2022, 15:15:13	http://127.0.0.1:4201/rich-text/edit-rich-text	Aug 31, 2022, 15:15:13	
Plain text	Aug 31, 2022, 15:15:13	http://127.0.0.1:4201/plain-text/edit-plain-text	Aug 31, 2022, 15:15:13	

Appendix II

Science Chaser Manager user manual

Surrounded by Science

Learning Paths towards Science Proficiency

Research and Innovation Action in the European Union's Horizon 2020 Programme

Grant Agreement no. 101006349

Appendix II

User Manual of the Science Chaser

Editor	Shant Derounian (UT)
Date	30 September 2022
Dissemination Level	Public
Status	Final

The Surrounded by Science project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement no. 101006349. This publication only reflects the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

User Manual of the Science Chaser

This appendix is a user manual for the Science Chaser intended to be used by project members and it should answer questions which might arise when using the Science Chaser. We are considering making some short videos of using the Science Chaser for the participants.

The project is still looking for better wording for science organisation, artefact, and content element. The better wording should give the correct idea to the participants and project members.

The Science Chaser will be made available in the languages of the countries that are represented in the Surrounded by Science consortium. The initial languages are English, Dutch, Portuguese, Italian, Greek and Hebrew. Other languages might follow later on. Project members will be asked to translate the English terms and text in the Science Chaser into their language.

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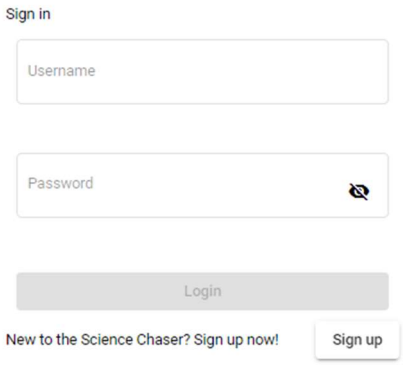
1 Access to the software

The Science Chaser is still in development and at the time of writing this user manual, it is only accessible for the project members and reviewers. In order to get access to the Science Chaser, please contact the project coordinator Tessa Eysink (t.h.s.eysink@utwente.nl).

1.1 How to login

In order to access the Science Chaser, a participant must log into the Science Chaser. If the user has not signed up yet, the user must go to the sign up screen and create a new account for the Science Chaser.

Figure 1. *Login screen*

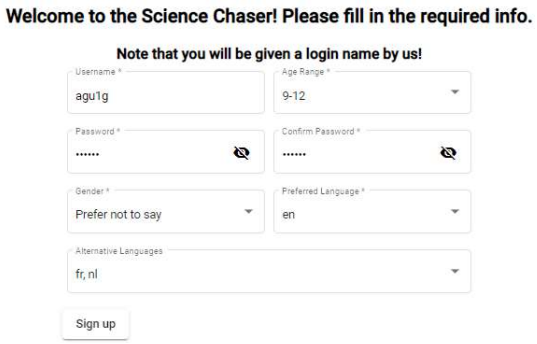


1.2 Sign up

If users do not have an account, they need to sign up via the sign up screen.

As the project wants to keep the user anonymous, the user should not enter their real name or email address as the login name. Instead, a login name is automatically generated by the app. To make it easier to remember the generated login name, the browser will prompt the user whether the login name and password should be stored.

Figure 2. *Sign up screen*



Upon signing up, the user is taken to the home screen of the app. The user is now able to log out and log back into the app by using the login name and password that were created during the sign up process. Thus, remembering the login name is very important, because if users forget their login name, there currently is no way to log back into the same account.

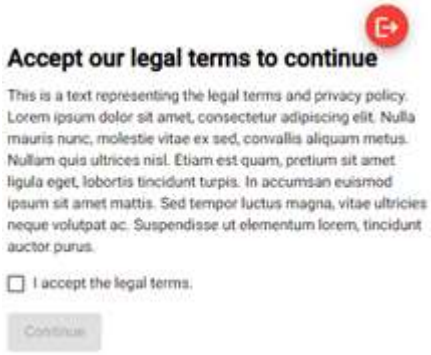
1.3 First time login

Upon the initial login, the users must go through a number of steps to unlock the app. Users only have to go through this procedure once.

1.3.1 Legal terms

The first screen the user is presented with, when logging into the app, is a screen explaining the legal terms of Surrounded by Science. If the user accepts these terms, he or she can continue to the next step, and if not, the user can stop using the app. (Note that the text for the legal terms is not ready yet)

Figure 3. *Accept legal terms*



1.4 Logging into the app

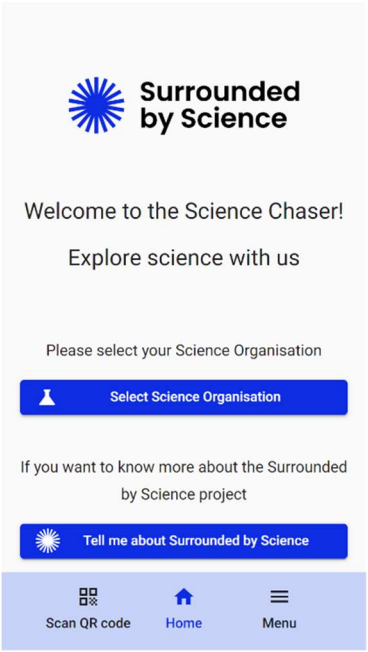
After going through the first time login steps, the user can login to the app. The user can input their login name and password to go to the home page.

2 Main features of the Science Chaser

2.1 Home section

The home section shown in Figure 4 is accessible by clicking the home button on the toolbar at the bottom of the page. It shows the logo of the Surrounded by Science project, alongside two buttons. The first button takes the user to the science organisation list described in section 2.5, and the second button takes the user to the Surrounded by Science public website (https://surroundedby.science).

Figure 4. *Home section*



2.2 Scan QR code section

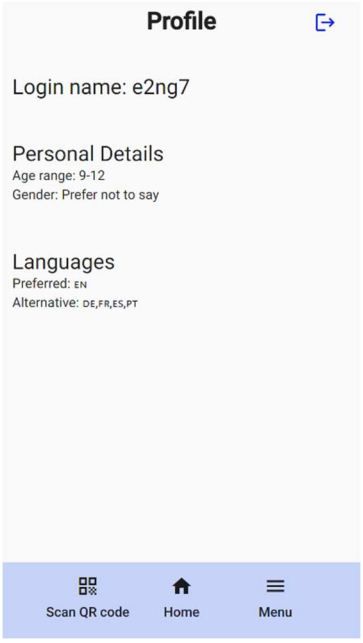
The scan QR code section shown in Figure 5 can be accessed by clicking the “Scan QR code” button on the bottom toolbar. This section features a QR code scanner, which will appear when the user clicks the “Start Scan” button. This scanner is able to scan special Surrounded by Science QR codes which will redirect the user of the Science Chaser to the corresponding science organisation, artefact, or content element.

Figure 5. *Scan QR section*

2.3 Profile section

The profile section shown in Figure 6 can be accessed by clicking the “Menu” button on the bottom toolbar, then clicking on “Profile”. The profile section can be used to check the details of the currently logged in user. This can be helpful to remember the login name of the user. In the nearby future, the user can change the personal details and languages. This section also has a logout button which logs the user out of the app.

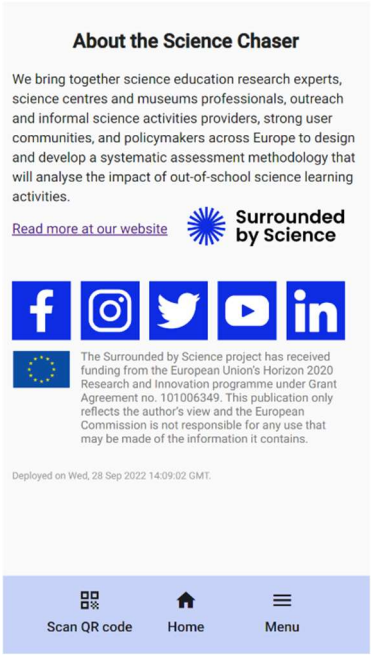
Figure 6. *Profile section*



2.4 About section

The about section shown in Figure 7 can be accessed by clicking the “Menu” button on the bottom toolbar, then clicking on “About”. The about section gives some information about the Surrounded by Science project, and has links to the projects’ social media pages. It also shows the time of the latest build.

Figure 7. *About section*



2.5 Science Organisation section

2.5.1 General information

The science organisations section can be accessed by clicking the home button on the bottom toolbar, and then clicking on “Select Science Organisation”.

The science organisations section is where the user of the Science Chaser can view the science organisations, alongside their artefacts and content elements.

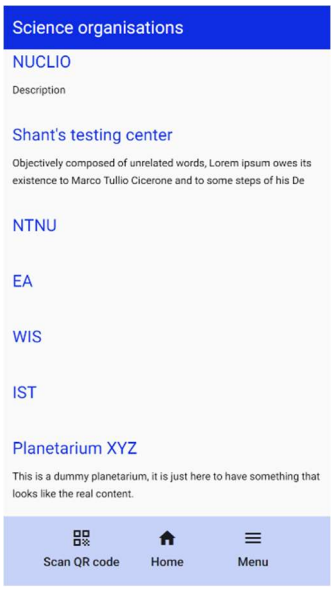
Note that some age restricted elements will not appear for all types of users.

2.5.2 Science organisations

2.5.2.1 Science organisations list

The science organisations list will show the list of science organisations along with some of their details (see Figure 8 for an example). When the user clicks a science organisation, he or she can view the details of that organisation (see Figure 9 for an example).

Figure 8. *Science organisations list*

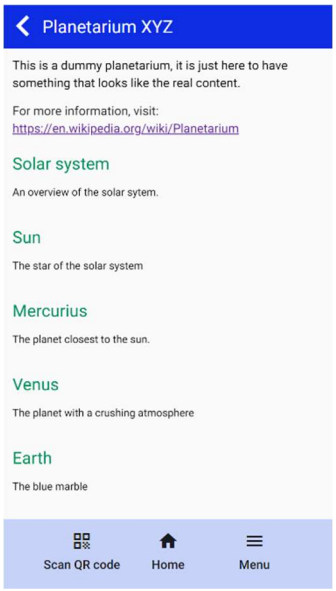


2.5.2.2 Science organisation details

On this screen (Figure 9), the user is able to view the details of the fictional science organisation called “Planetarium XYZ”. Here the name of the organisation “Planetarium XYZ” is shown, alongside the URL of the website of this organisation.

This fictional science organisation has multiple artefacts, which are the “Solar system”, “Sun”, “Mercurius”, etc. These artefacts represent real world “exhibits” which belong to the science organization. After clicking an artefact, the user is taken to the artefact details page (Figure 10). We will be using the artefact “Sun” in our examples below.

Figure 9. *Details of the science organisation “Planetarium XYZ”*



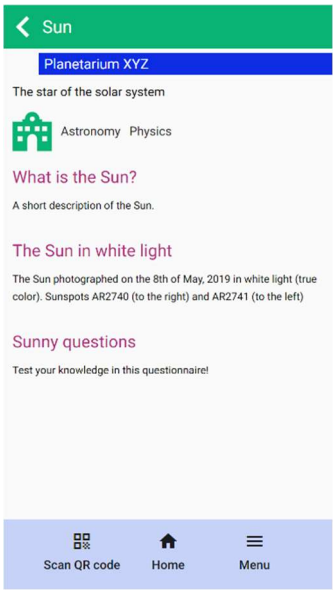
2.5.2.3 Artefact details

On this screen (Figure 10) the user can see the details of the artefact called “Sun”. Currently, the user can see the name of the artefact, the description, the relevant domains, and an icon showing whether the artefact is intended to be viewed indoors or outdoors. The user also sees the list of content elements attached to this artefact, shown in pink.

The content elements are pieces of information attached to the artefact. For example, “The Sun in white light” (Figure 11) is a content element providing an image of the sun, alongside a text which gives information about the Sun to the user. Another example is “Sunny questions” (Figure 12), which is a questionnaire regarding the artefact “Sun”.

After clicking a content element in the list, the user is taken to the content element details screen (Figure 11, Figure 12). The user can click the top left back button to go back to the science organisation list (Figure 9).

Figure 10. *Details of the artefact “Sun”*



2.5.2.4 Content element details

On this screen (Figure 11, Figure 12), the user can view the content element in action, in their language of choice. Content elements are language dependent, for every language a separate content element has to be created. Here the user can interact with the content element, or go back to view another one if they wish, using the back button.

Figure 11. *Content element "The sun in white light"*

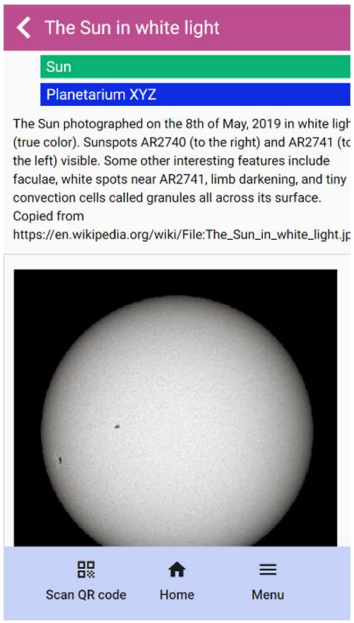
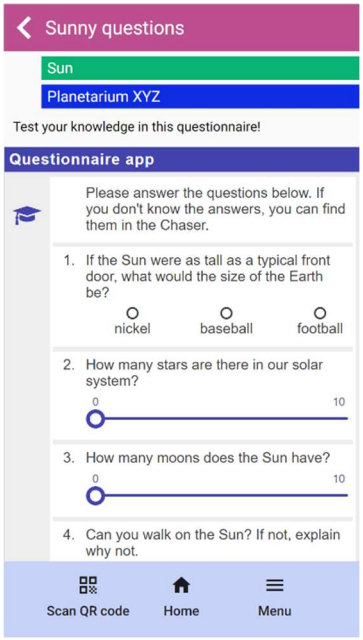


Figure 12. *Content element "Sunny questions"*



Appendix III

Content plugin documentation

Surrounded by Science

Learning Paths towards Science Proficiency

Research and Innovation Action in the European Union's Horizon 2020 Programme

Grant Agreement no. 101006349

Appendix III

Surrounded by Science plug-in documentation

Editor	Jakob Sikken (UT)
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SbS plug-in documentation

Introduction

The Digital Toolbox Manager (DTM) and Science Chaser (chaser) are using plug-ins to edit and show the content elements of an artefact. The chaser and DTM are using Channel Messaging to communicate with the plug-in (https://developer.mozilla.org/en-US/docs/Web/API/Channel_Messaging_API).

Each type of content plug-in must support two different plug-ins: one for editing (used in the DTM) and one for viewing (used in the chaser). Both types of plug-ins are using the same communication protocol.

Editing plug-in

The editing plug-in will be used in the DTM, it will allow the project members to configure the content to be displayed in the chaser by the viewing plug-in. The configuration is stored in the content element by the DTM.

Viewing plug-in

The viewing plug-in will be used in the chaser, it will display the content which was configured in the DTM. The plug-in might support interaction with the user, e.g. by showing some questions and let the user enter the answers. The state can then be sent to the chaser, which will store the state.

Message format

All messages are JSON objects with the following structure:

```
{
  "command": <string>,
  "message": <json>
}
```

The following commands are defined:

1. `init` - init data for the plug-in
2. `accepted` - the plug-in has accepted the connection
3. `updateConfiguration` - update the configuration of the plug-in
4. `updateState` - update the state of the plug-in
5. `sendlogAction` - store a log action describing an interaction with the plug-in

In the future additional commands might be added.

Init

The init data is sent with the initial message from the host to the iframe. The initial message contains the following data:

```
export interface ChannelInitialisationData {
  language: string
  configuration: json
  state: json
}
```

The configuration and state formats are defined by the plug-in. The configuration is the content of the last updateConfiguration message. The state is the content of the last updateState message.

Accepted

The accepted message is sent from the iframe to the host to indicate that the iframe is ready to receive messages.

This message has no content

Update configuration

The update configuration message is sent from the iframe to the host to update the configuration of the plug-in. The configuration is the result of the project member configuring the content of the plug-in in the DTM.

The content of the message is the configuration in JSON format.

Update state

The update state message is sent from the iframe to the host to update the state of the plug-in. The state is created by the participant entry in the plug-in in the chaser.

The content of the message is the state in JSON format.

Send log action

The send log action message is sent from the iframe to the host to save the log action. The log action describes a participants action in the plug-in in the chaser.

The content of the message is the action log in JSON format.

Example channel messaging code for the plug-in

The Twente team has created a general channel messaging client, which handles the setup of channel messaging and the details of sending and receiving channel messages. Besides working in the chaser and DTM, it can also be used directly (meaning not in an iframe). This makes it easier to develop and test the plug-in. The saved configuration and state will then be stored in local storage of the browser and returned to the plug-in through the init message.

Please contact the Twente team to get the latest verion of the channel messaging client.

The plug-in only needs to call getChannelMessagingClient() to get the channel messaging client. The channel messaging client will be returned after channel messaging has been established.

```
const channelMessenger = await getChannelMessagingClient('plainText')
```

Once the channel messaging client is available, the plug-in can send and receive messages. The interface of the channel messaging client is:

```
export enum ChannelCommands {
  init = 'init',
  accepted = 'accepted',
  updateConfiguration = 'updateConfiguration',
  updateState = 'updateState',
}
```

```
ر

export type json = any

export interface ChannelMessage {
  command: ChannelCommands
  message: json
}


export type channelMessageListener = (channelMessage: ChannelMessage) ⇒ void

export interface ChannelInitialisationData {
  language: string
  configuration: json
  state: json
}

export interface ChannelMessenger {
  readonly channelInitialisationData: ChannelInitialisationData

  addChannelMessageListener(listener: channelMessageListener): void

  removeChannelMessageListener(listener: channelMessageListener): void

  sendMessage(key: ChannelCommands, message: any): void
}
```