



SEAL

Student and Citizen Identities Linked

D5.3 Testing report

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List of Acronyms

Abbreviation / acronym	Description
AP	Attribute Provider
AuthN	Authentication
CEF	Connecting Europe Facility
DID	Decentralised Identifier
DSA	Domain Specific Attributes
Dx.y	Deliverable number y belonging to WP x
eIDAS	Electronic Identification Authentication and trust Services
EU	European Union
GUI	Graphical User Interface
HEI	Higher Education Institution
IdP	Identity Provider
IF	Interface
KYC	Know Your Customer
LoA	Level of Assurance
ms	microservice
MS	Member State
OIDC	OpenID Connect
PDS	Personal Data Storage
SAML	Security Assertion Markup Language.
SEAL	Student and Citizen Identity Linked
SSI	Self Sovereign Identity
SP	Service Provider
UA	User Agent
UX	User Experience
UI	User Interface
VC	Verifiable Credential
VLE	Virtual Learning Environment
WAYF	Where Are You From?

Executive Summary

The main goal of this deliverable “Testing report” is to provide the student engagement and testing methodology, resources and outcomes of three types of tests: a) automated pre-production testing with test credentials, b) production testing with real users and c) usability testing with end users students.

The test report fully demonstrates the use of the implemented functionality of the SEAL Service as per its documented implementation in Activity 3, its integration by the university services, and the publically available SEAL Web Dashboard and Mobile apps published on Google Play Store.

In detail, the tests conducted covered:

- the issuance of SEAL identities (in production and pre-production environments, via test and real eIDAS eID, eduGAIN credentials and eMRTD documents) covering both the Web and Mobile SEAL interfaces of the SEAL Platform;
- the consumption of SEAL issued identities (in production and pre-production environments, via test and real Linked eIDAS eID and eduGAIN credentials) at the customized university services in order to gain access to the respective services;
- the usability testing (in production environment with real end user students).

The test report concludes a statistical analysis of the collected feedback from the usability testing with real end user students.

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1. Introduction

1.1 Purpose of the document

This deliverable “Testing Report” is the verification of the Milestone 14 of the SEAL project, associated with the Tasks 5.3 “Students awareness campaign, recruitment for testing and SEAL Mobile App deployment and support”, 5.4 “Pre-production level semi-automatic validation tests to improve the quality and efficiency of the test process” and 5.5 “Production testing, feedback collection, usability test”¹.

The work undertaken within the framework of Tasks 5.3, 5.4 and 5.5 evaluates the functionality and the impact of the SEAL platform as well as the online academic services connected to the platform and provided by the SEAL HEI partners:

- University of Malaga (UMA),
- University Jaume I (UJI),
- University of the Aegean (UAegean) and
- University of Porto (UPORTO).

Specifically, the document:

¹ **Task 5.3: Students awareness campaign, recruitment for testing and SEAL Mobile App deployment and support**

The Mobile app will be connected to the platform, along with the interface to link and bootstrap identities with the Members State backed identities (eIDAS eID, ePassport). **It will be published and engagement and visibility activities will be carried out to the students of the participating HEIs to promote the collaboration in testing the app and the HEI services connected to the linking service.** Also, once the SEAL interface is added to already existing UMA university apps, **their communications channels will be used to raise user awareness.**

Task 5.4 - Pre-production level semi-automatic validation tests to improve the quality and efficiency of the test process

To efficiently operate cross-border and cross-system testing of the functionality of the deployed platform, a largely-automated, software-based system will be used, exploring the techniques of headless browsing. It will enable, for test credentials, **the automated execution** of the federated identity management process and of the different authentication processes based on the core components of this identity. It will also provide an **automated logging of events/errors/failures.**

Task 5.5 - Production testing, feedback collection, usability test

This task will organize pools of real users that will test the **functionality of the SEAL platform services** in concrete cases to demonstrate the use of the federated identity with different identification requirements. Beyond the functionality of the SEAL platform services, this task will include **usability tests to verify the user-friendliness** and the extent to and the extent to which the user’s expectations and attitudes are addressed. This feedback will be **taken into account** to further improve the usability of the platform. At least **20-30 students** will test the platform, including **at least 5 mobility students from other EU/EEN countries.**

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1. Provides a short description of the SEAL Platform and the SEAL HEI Services;
2. Reports on the Pre-production Automated Testing;
3. Reports on the cross-border Production testing with real eIDAS-eID;
4. Reports on the the usability testing

1.2 Relation to other project work

The activities described in this document relate the testing of the SEAL Platform with:

- what was designed in Activity 2 (Linking Service Core Platform and Interfaces Design)
- what was implemented in Activity 3 (Linking Service Core Platform and modular interfaces development)
- the SEAL HEI services which were customized and integrated with the SEAL platform in Activity 4 (End user services customization and integration of the project).

Further, the outcomes of Activity 5, described in this document, will be further exploited in Activity 6 Impact creation, sustainability, and road mapping of the project.

1.3 Structure of the document

This document is structured in 5 major chapters

- **Chapter 2:** provides overview of the SEAL Identities issuance and their consumption from the SEAL HEI services.
- **Chapter 3:** describes shortly the SEAL HEI services connected to the Platform and presents their flows.
- **Chapter 4:** provides demonstration of testing the issuance of the SEAL identities by the SEAL Platform and their consumption by the SEAL HEI services, using an automated test approach at the pre-production environment.
- **Chapter 5:** provides a detailed description of the test cases performed with real eIDs that were used to verify a) the correct issuance of SEAL identities and b) the effective operation of SEAL HEI services.
- **Chapter 6:** presents the results of the usability testing and the collected feedback.

A table illustrating all performed tests and obtained results constitutes an integral part of this deliverable and can be found at the Annex.

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2. SEAL Linked Identities and HEI Services

The SEAL platform supports academic end users to allow them to combine their civil (eIDAS eID, eMRTD) and academic (eduGAIN) identity profiles to access cross-border HEI services (mainly services supporting mobility programs) in a decentralized, user-centric manner.

Essentially, the SEAL platform provides a means of alleviating the pressure from the centralized federated identity provider infrastructures (which is often the cause of bottleneck) and empowers its users to receive, securely store and reuse their identities in such a way that their linking is made explicit to the final Service Provider. Additionally, due to its decentralized nature it enhances the privacy of the users and ensures GDPR compliance. SEAL does not store any user identities in a central repository but facilitates the user to store their identity in a Personal Data Store (a SEAL generated and signed file, encrypted using the users secret), or alternatively as W3C compliant Verifiable Credentials (VC) on one of the supported Self-Sovereign Identity (SSI) wallet applications installed on the users mobile phone².

2.1 SEAL Platform: Identities issuance

2.1.1 Personal Data Storage

A SEAL Personal Data Storage (PDS) is an abstract representation of the user data as standard objects, written in JSON format and encrypted through a password provided by the user. As such, the data is only decrypted and handled if the user provides the proper password. To ensure that the user has not tampered with the contents of a PDS, its content is also signed by a SEAL service instance.

SEAL supports two different kinds of objects:

- Datasets obtained from identity and data sources;
- Links, which are objects that establish relations between identities (stating, to a level of assurance that two referenced datasets belong to the same person).

For the user's convenience, PDS can be stored in multiple ways:

- Exported and stored on the local user's device;
- Exported and stored on other online means

Via the SEAL service, the user is in full control of their PDS. As a result, the user can: add new datasets from sources, delete unwanted datasets, and request the assertion of new links between imported datasets, update existing datasets, update the PDS and so on. A PDS provides metadata on the identity of the issuer, timestamp of imported attributes and on the trustworthiness of the contained information based on the signature of the SEAL platform on the data.

²For more details regarding the features offered by the SEAL platform please review [D3.1 Technical documentation on common code of Platform](#).

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2.1.2 Verifiable Credentials (LinkedIDs)

Verifiable Credentials³ (VCs) can be defined as digital identification cards securely stored in a user’s “wallet” app in their controlled device. They can be thought of as the digital equivalent of physical identity cards which are stored in a physical wallet. Users can present these VCs to Relying Parties (i.e. Service Providers) that validate them and use the contained information to provide access to their services (the same way we present physical identity cards in everyday life to access physical services). Just like physical identity cards, VCs originate and explicitly reference an Issuer, i.e. the entity Issuing and guaranteeing the accuracy of the contained information. The key difference is that Verifiable Credentials are tamper evident and are bound to their holder (i.e. entity to whom they were issued to) via cryptographic means, making them impossible to counterfeit.

Specifically, a Verifiable Credential consists of a (set of) claim(s) regarding an entity made by an Issuer. Usually, a credential will include metadata about the Issuer, the expiry date, and means of verifying its integrity. Additionally, it might include metadata about revocation mechanisms used and so on. A Verifiable Credential (VC) is defined as a set of tamper-evident set of claims and metadata about those claims such that ownership and authorship can be cryptographically proved. In more details, a typical Verifiable Credential apart from the actual claims includes metadata about:

- The time of issuance;
- The identity of the Issuer;
- The subject of the credential;
- The type of credential;
- The verification means (proof).

These concepts are usually referred to as the Credential Graph and the Proof Graph (the proof graph contains the details of the verification means) shown in the following picture.

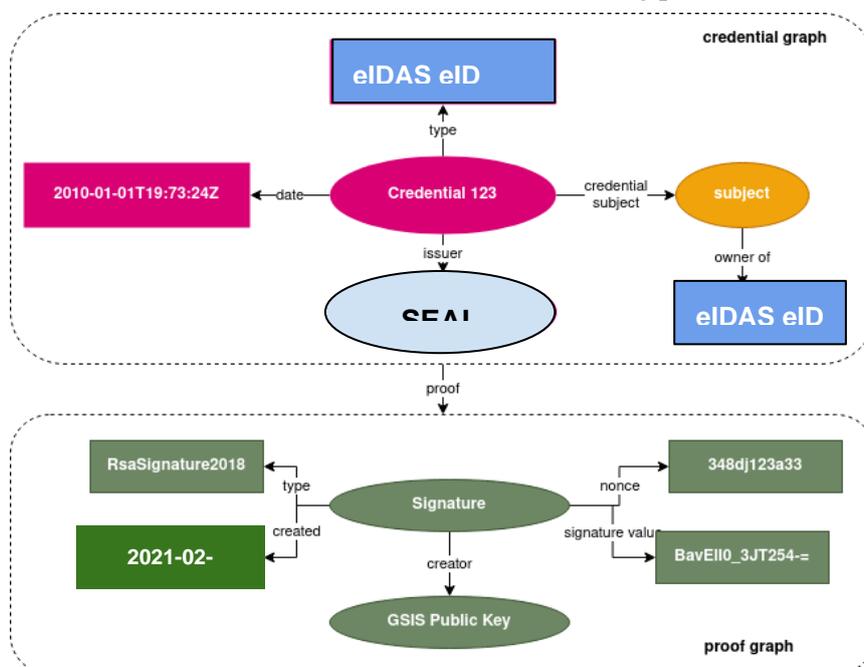


Figure 1: Credential Graph and the Proof Graph

³ <https://www.w3.org/TR/vc-data-model/>

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The SEAL platform fully supports the issuance of Verifiable Credentials using the connected identities sources (eIDAS, eduGAIN, eMRTD⁴), as well as the issuance of Verifiable Credentials from the linking of the aforementioned sources.

Specifically, the SEAL VC service, using specialized interfaces, allows the users to:

1. Pair their wallet app (currently uPort and Jolocom are supported⁵)
2. Import their identification information from the connected authoritative sources
3. Use these as assertions to issue Verifiable Credentials to the user's wallet attesting to the imported attributes and their links⁶

In more details, via the SEAL platform users can issue the following VC identity cards⁷:

- **“myeIDAS-ID”**. A Verifiable Credential (VC) anchored to EU eIDAS eID.
- **“myeduGAIN-ID”**. A Verifiable Credential (VC) created with the academic attributes provided by the eduGAIN.
- **“myLinkedID”**. A Verifiable Credential (VC) linking the eIDAS eID with the eduGAIN identity.

2.2 SEAL HEI Services: Identities consumption

In order to access a SEAL enabled service, a user needs to be in control of a SEAL issued identity (myIDs), either in the form of a PDS or a Verifiable Credential. Once obtained, the user can present the aforementioned SEAL assured identity to authenticate to the SP and gain access. Verification of the users' identity by the Service Provider can either be delegated to the SEAL platform over standard OIDC or SAML federated interfaces, or it can even be verified locally by the SP (for SSI VC myIDs only) without connecting to the SEAL platform.

In more detail, for federated authentication via the SEAL platform and depending on the preference of the Service Provider the authentication takes place over either SAML or OIDC. Specifically, the typical flow implemented by the SPs to authenticate the users using a SEAL federated approach is as follows:

1. The user accesses SEAL partner SP service.
2. The user clicks a designated button (e.g. login using “myIDs”)
3. The SP generates an SAML or OIDC authentication request to the SEAL platform.
4. The user is informed about the data the SP has requested and is asked to consent on their disclosure.
5. The user is prompted to select their preferred myID source to authenticate on the SEAL platform, i.e. PDS or Verifiable Credential. It should be made clear here that the users' data

⁴ eventually via the SEAL mobile dashboard app

⁵ <https://developer.uport.me/>, <https://jolocom.io/>. However, as Jolocom support was added at the end of the project only the integration with uPort was tested and is reported here.

⁶ eventually signed by an eSEAL to enhance the target framework

⁷ For more details please visit the myID Cards website: <https://www.myids-i4mlab.aegean.gr/uaegean-myids-the-full-set>

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do not reside on the SEAL platform, as it only acts as a **verifying proxy** for the PDS or VC and facilitates their consumption over industry standard protocols.

6. The SEAL platform receives the users PDS file or Verifiable Credential, verifies their authenticity (and performs additional actions depending on the format used) and generates an appropriate SAML or OIDC response and sends it back to the SP.
7. The SP receives the requested user's attributes and authenticates them, eventually proceeding with their business flow.

Alternatively, in the case of Verifiable Credentials, the SP can directly request them from the user's wallet, validate them and grant access accordingly, without delegating this task to the SEAL platform. This provides HEIs with the flexibility and scalability needed in the case of a large-scale operation. Also, to reduce the barrier of entry to SPs without sacrificing the privacy of the users SEAL has open sourced an OIDC/SAML server that is capable of converting OIDC/SAML request to SEAL myIDs VC disclosure requests, parse the response and return the assertions to the SPs over OIDC or SAML to the SP.

Of course, the user's identities issued by SEAL must be periodically re-issued to ensure their freshness. Verifiable Credentials contain an expiration date to ensure the accuracy of the information contained. Currently the SEAL VC Issuer issued VCs are set to expire every 3 months to keep the credentials fresh and increase security. However, the exact expiration date is fully configurable to satisfy the needs ecosystem the VC issuer is deployed in.

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3. HEI Services

3.1 SEAL HEI Services: Short Description

This section describes the relevant information covering the SEAL HEI Services of University of Porto (UPorto), University of Aegean (UAegean), Jaume I University (UJI) and University of Malaga (UMA).

#	SP	Service Title	Service URL
1	UPorto (PT)	University of Porto EWP Service	https://ewp-dev.up.pt/gui/login
2	UJI (ES)	UJI Personal Data Management Service	https://ujiapps.uji.es/ssi/rest/identificadores
3	UAegean (GR)	UAegean myID Card	https://www.myids-i4mlab.aegean.gr/get-yourid-card
4	UAegean (GR)	UAegean SmartClass	https://eideusmartclass.aegean.gr/
5	UAegean (GR)	UAegean Online Course on Cyber Security	https://eclass.aegean.gr/courses/TMOD235/
6	UAegean (GR)	UAegean Central Authentication Service	https://erasmus-cas.aegean.gr:8443/login
7	UMA (ES)	UMA Centralised Identity Authentication Service	https://dumades.uma.es/directorio/misdatos/
8	UMA (ES)	UMA Identity self-provisioning Service	https://pilotopruebas.cv.uma.es/

3.2 University of Porto Services

3.2.1 University of Porto EWP Service

The University of Porto EWP Service is responsible for providing and searching institutional and student data in the EWP network connected HEIs, easing the process of finding mobility information and exchange of such data. This portal uses the SEAL Authentication methods to identify the logged-in student, extracting the needed attributes and search for his/her data in his home institution, if he/she is part of a specific mobility. The Service allows Erasmus+ students that arrive in U.Porto to easily,

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and without any paperwork, retrieve their data from his/her home institution and automatically find the status of his/her Mobility application and other related information.

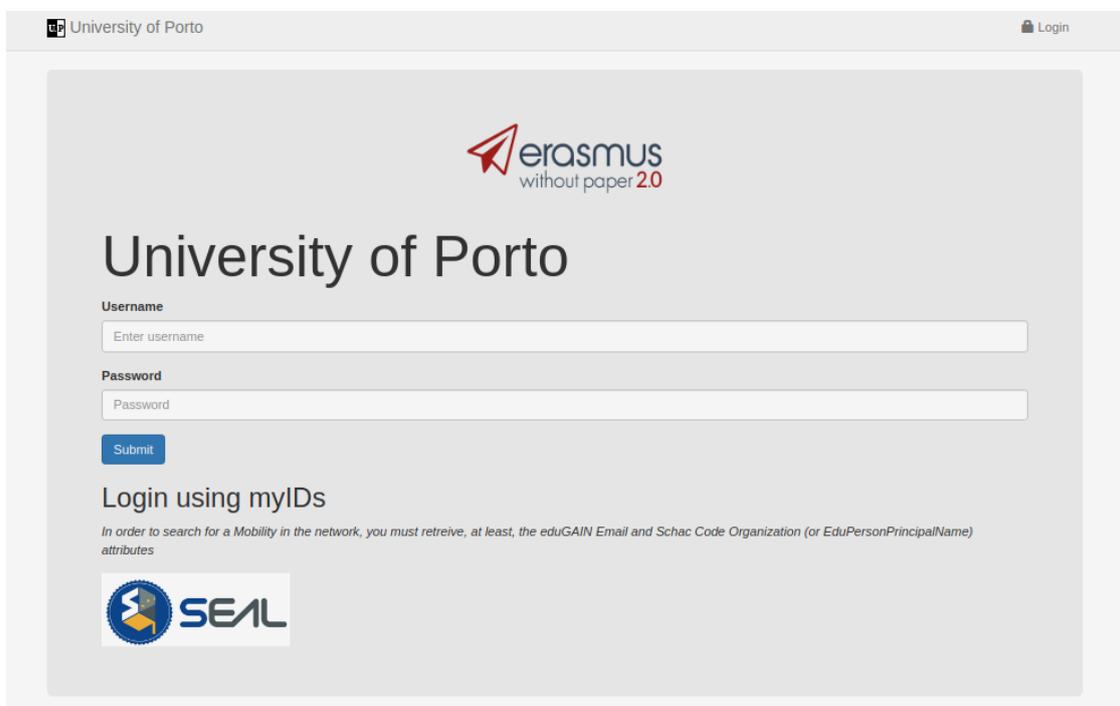


Figure 2: University of Porto EWP Service home page

Since the SEAL myIDs process doesn't need any registration in UPorto's portal, the student doesn't require an UPorto username and password to access the EWP UPorto Portal. This makes the process of accessing it much easier, faster and safer. By using SEAL authentication, the user shares his/her attributes with the portal. This way, he/she is always informed about the attributes that will get imported by the platform and can always change them according to their needs. After the user's successful authentication, the UPorto portal will search for his/her home institution in the EWP network, using the SEAL data received, extracting the needed parameters, such as the home HEI SCHAC code.

In summary, the data retrieved from the consumption of the credentials is used to authenticate and identify the user and recognise the sending institution. Additionally, the user myID's, imported through EWP, are used to populate the user profile, and allow them to automatically fill in any required application in U.Porto (the receiving institution).

3.3 Jaume I University Services

3.3.1 UJI Personal Data Management Service

The UJI Personal Data Management Service is a management tool of the user's identities. It is common for foreign students to have their identifiers changed and updated from the moment they enrol to the moment they start taking the courses. Also, time-limited enrolment of students from

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shared programs is a challenge and many times students get to have two different accounts belonging to the same person. The UJI Personal Data Management Service allows the user to import identifiers and links from any source supported by SEAL. After each import, the application will run a matching algorithm to deduce from all the imported identity and link data which identifiers can be trustfully considered paired with the authenticated identity.

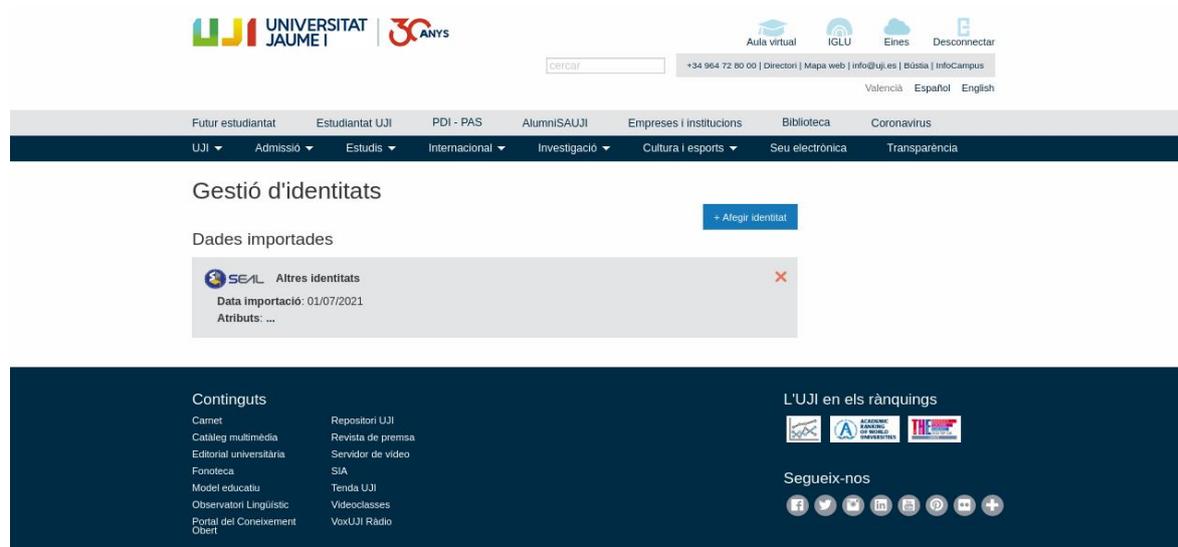


Figure 3: UJI Personal Data Management Service Dashboard

The Service allows the user to delete or import more identities, managing those credentials in one single place. Any authenticated user will be able to import identity data from the available federated sources (which includes the different SEAL identity sources). After a successful import, a validation algorithm finds any multiple account, enrolment and mutating identifier issues.

3.4 University of Aegean Services

3.4.1 UAegean myID Card

Paper-based proofs of academic affiliation are easily lost, misplaced and are also very easy to counterfeit. Additionally, there is no means currently by which a mobility student can retrieve such a proof before arriving at the university. The UAegean myID Card Service implements a convenient way for ERASMUS students at the University of the Aegean to issue a Disposable UAegean Digital Credential, proving their academic affiliation.

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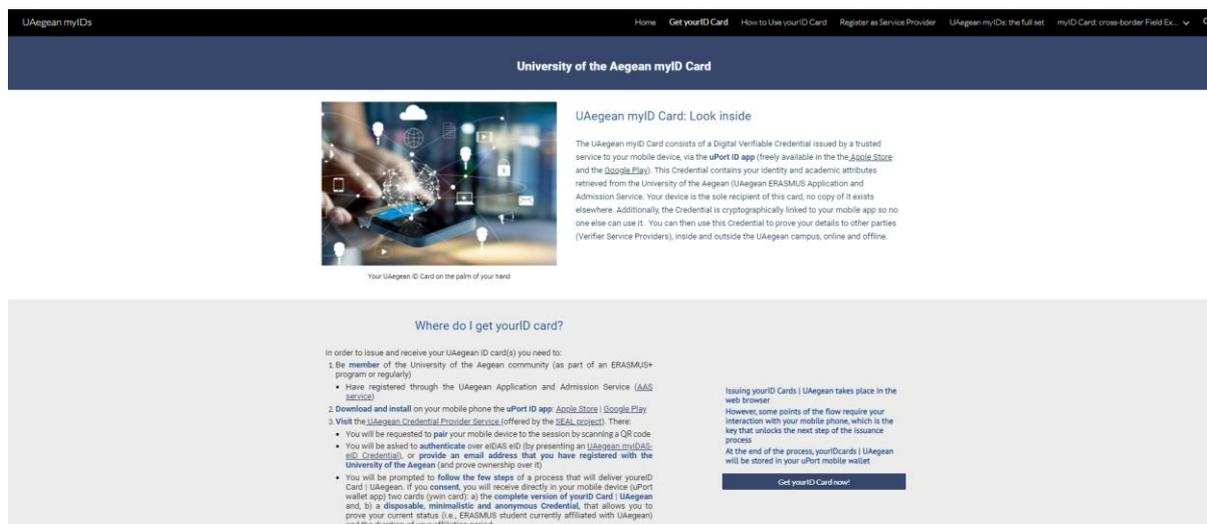


Figure 4: UAegean myID Card Service home page

This Disposable credential can be used at various (mainly local) service providers (like bookstores, restaurants and so on, in the premises of the University of the Aegean) to prove the student’s ERASMUS status without any paperwork. Using this service, the students will be able to do so even before arriving at the university (as they will be able to issue their ID Card just after their acceptance to the UAegean ERASMUS program). The Service confirms the user’s identity by utilizing the SEAL authentication method. Using an eIDAS or eduGAIN eID each student can access their credential without having to register to any Service. Next, the student can use this to prove their academic affiliation to services either online or on physical premises.

3.4.2 UAegean SmartClass

The UAegean SmartClass Program consists of an online education/conferencing facility for the UAegean community and partners, enabling the quick creation of virtual teaching/conference groups and automating access to authorized users. The Service also provides keyless access (via an IoT interface) to a physical classroom located at the University of the Aegean.

Prior to its integration with SEAL, users could gain access to both the physical classroom and the online services via an eIDAS eID authentication or using the University IdP. Specifically, in order to access the services, the users need to first register to the service and become authorized by an administrator of the system.

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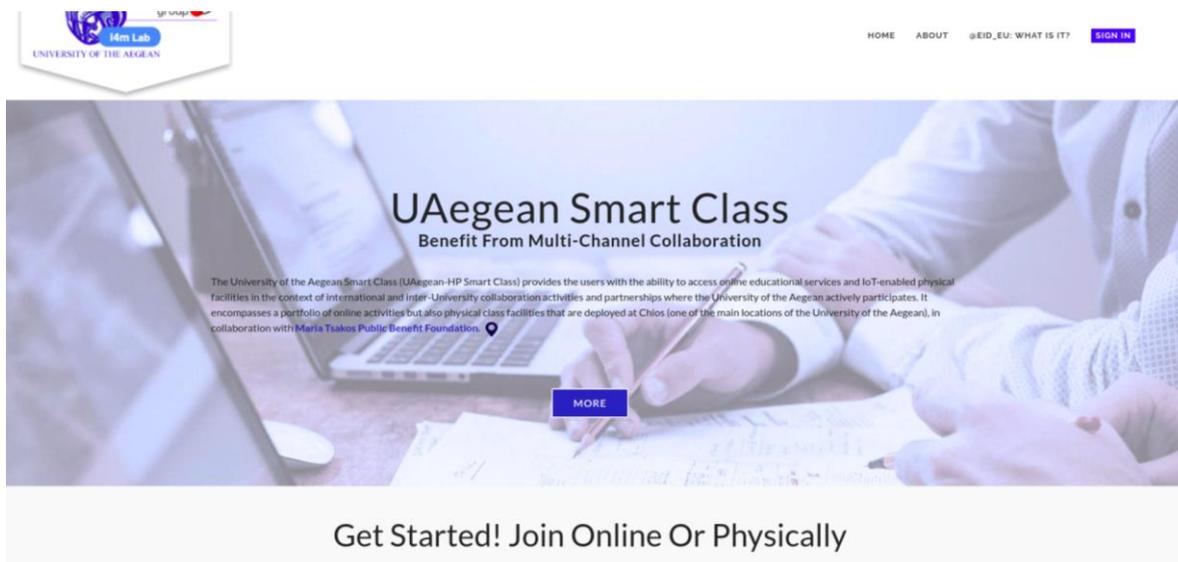


Figure 5: UAegean SmartClass Program home page

Specifically, the users had to:

1. Authenticate using one of the aforementioned identification schemes:
2. Submit additional identification information (including their academic affiliation):
3. Submit their application.

Next, a system administrator verified the submitted information they were granted access to the service. However, this verification resulted in a non-trivial administrative burden.

After the integration with the SEAL platform the users are able to register using their linked eIDAS-eduGAIN “myIDs” issued from the SEAL service. Thus, the users are not required to manually submit any additional identification information, which in turn greatly simplifies the verification efforts required by the system administrator.

3.4.3 UAegean Online Course on Cybersecurity

The UAegean Online Course on Cyber Security is an online course taught at the University of UAegean. A UAegean student (even one studying in the University as part of the Mobility Project) can register for this course using their myIDs Credential.

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Figure 6: UAegean Online Course on Cyber Security home page

The user fills in their email information and scans the Service’s QR to pair their eWallet, containing their linked eIDAS-eduGAIN “myIDs” issued from the SEAL service. After confirming their identity, an invitation will arrive at the user’s email informing them of their acceptance to the Course. The student can now access the Microsoft Teams course lessons. The registration doesn’t need to be repeated since the user is effortlessly and without error authenticated through the Service and identified as a UAegean or a UAegean ERASMUS student.

3.4.4 UAegean Central Authentication Service (CAS)

All persons affiliated with the University of the Aegean are issued with local UAegean credentials. However, the process of issuing such credentials is time consuming and adds an administrative overhead to the University service operators, especially when managing temporary credentials (which is the case for mobility students).

For this reason, the UAegean CAS was connected to the SEAL Platform to allow users to authenticate using SEAL issued Verifiable Credentials as an alternative way to the local credential authentication flow.

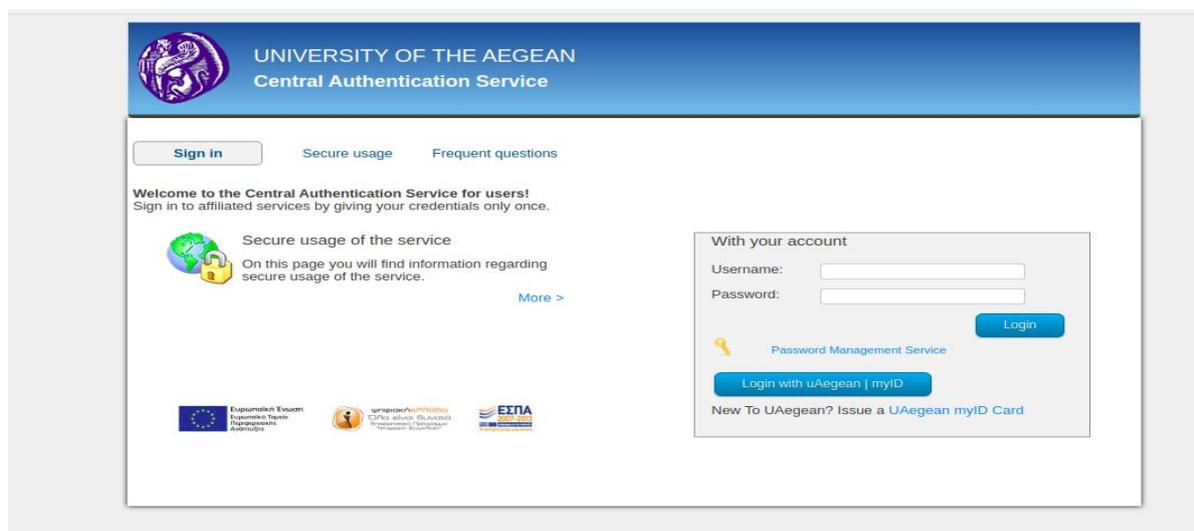


Figure 7: UAegean Central Authentication Service home page

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As a result, from the CAS login interface the user can select to authenticate using their “uAegean | myID”. Next, a SEAL Issued VC disclosure request is presented to the user that satisfies it using the mobile wallet app. After the successful VC validation, the user is successfully authenticated by the CAS. The service is currently offered to ERASMUS students.

3.5 University of Malaga

3.5.1 UMA Centralised Identity Authentication Service

Every person needing access to University of Málaga web-based services is redirected to the university’s central Identity Provider. The UMA Centralised Identity Authentication Service now in addition uses the SEAL myIDs method as a means of authentication. The user can authenticate using the SEAL Platform and both the person’s identity and the attributes provided by SEAL are passed on to the requested service for authorization of use.

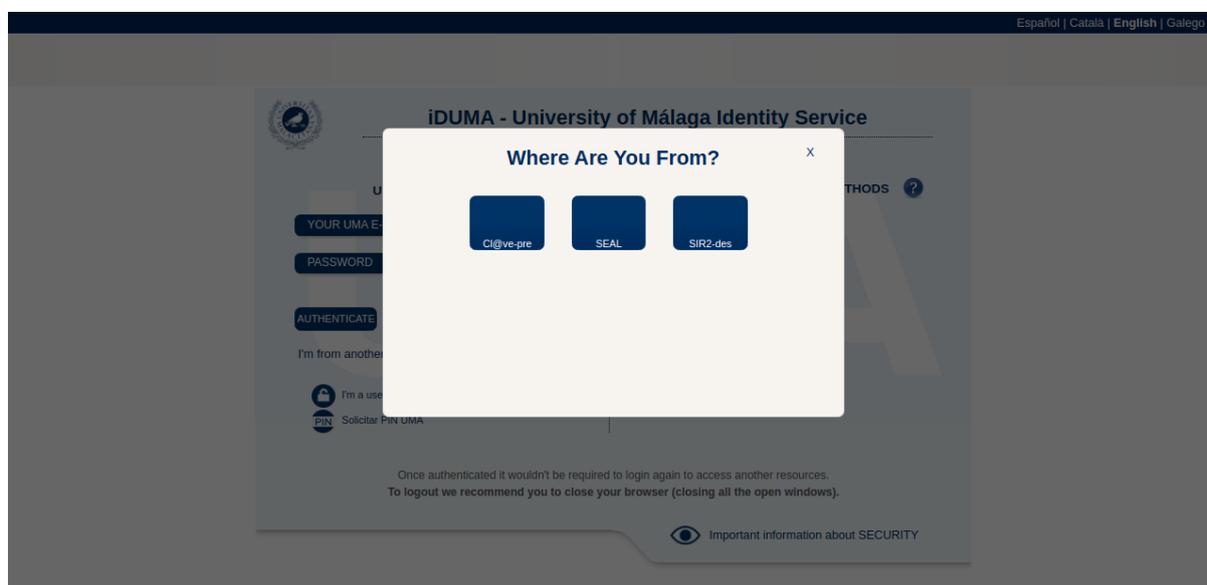


Figure 8: UMA Centralised Identity Authentication Service home page

By utilizing the SEAL Platform, the Service does not require the person to have a University account and allows access if the provided attributes validate them to the service. The authorized student can now use the Service the same way a UMA student would.

3.5.2 UMA Identity self-provisioning Service

The UMA Identity self-provisioning Service uses the SEAL Authentication method for registering. One of the most burdensome tasks of UMA’s Centralised Identity Authentication Service is managing the data of students that are not registered in one of the University’s systems of record. The Identity self-provisioning Service uses the SEAL myIDs as a means to safely and accurately self-enroll in the UMA Virtual Campus and has the student’s attributes automatically added to the identity repository.

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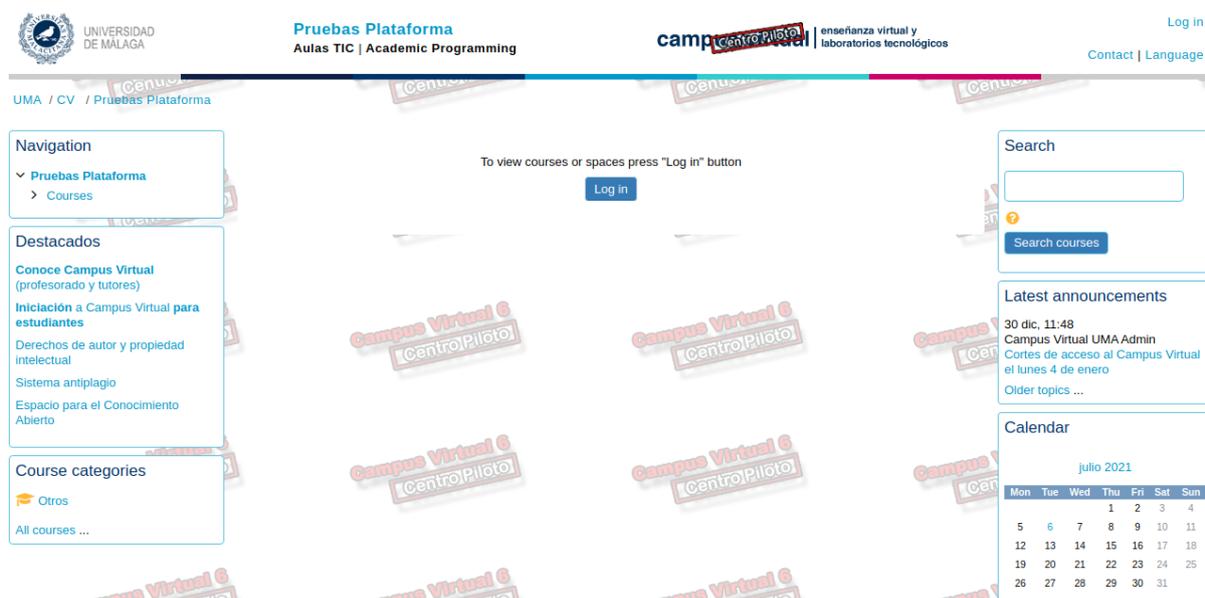


Figure 9: UMA Identity self-provisioning Service home page

3.6 SEAL HEI Services: Flows

This section describes in brief the flows a user goes through in order to access one of the aforementioned services leveraging the SEAL infrastructure.

3.7 University of Porto Services

3.7.1 University of Porto EWP Service

Service flow

1. The user accesses the EWP login page of the University of Porto Service Provider.
2. The user selects SEAL “myIDs” as their preferred method of authentication.
3. The user is redirected to SEAL Identity Provider.
4. The SEAL Identity Provider manages the authentication flow.
5. The user is redirected to the UPorto EWP Service.
6. The user is logged into the service and authorized based on the attributes received.
7. The user uses the EWP Service to search for their Mobility status at the University of Porto.

3.8 Jaime I University Services

3.8.1 UJI Personal Data Management Service

Service flow

1. The user accesses the Service using their UJI Credentials.
2. The user clicks “Add identity” and chooses their preferred method of authentication.

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3. The user is redirected to the eIDAS, eduGAIN or SEAL Identity Provider⁸ depending on their choice.
4. The Identity Provider manages the authentication flow.
5. The user is redirected to the UJI Personal Data Management Service.
6. The main screen will show the different alternative identities the user has already imported and have been validated, and a list of the imported datasets from which the validated identities have been excerpted.

3.9 University of Aegean Services

3.9.1 UAegean myID Card

Service flow

A) Service Provider Registration

1. The SP reaches the myID Cards website.
2. The SP registers by completing the Registration Form.
3. The admin downloads the registration in csv format.
4. The admin uploads the csv while an email is sent to the SP informing them about the Service and providing them with contact information. The email contains a url the SP can use in enable its user to prove their status using their UAegean myID cards (and a QR encoded version of the aforementioned URI).

B) myID Card Issuance

1. The student reaches the myID Cards website.
2. The student is informed about the Service and clicks “Issue now your UAegean ERASMUS myIDs Card(s)” to start with the process.
3. The student is redirected to the SEAL VC issuer.
4. The student is asked to authenticate over
 - a. eIDAS eID
 - b. eduGAIN
 - c. Verified email
5. The student requests the Issuance of the UAegean myID Card by clicking the “Issue” button.
6. The student receives in their mobile wallet app two VCs:
 - a. UAegean myID Card
 - b. UAegean Disposable ID

C) Student Verifies their Erasmus Affiliation

1. The student reaches the SP verification service, either by
 - a. Scanning a QR code the SP makes visible on their premises (to deliver their disposable myID Card)
 - b. Visiting the SP link directly (or viewing it over the SPs device). Each SP is issued a unique URI in order to verify the affiliation of the users as explained on the SP

⁸ Of course, in this case the user needs to have previously created their SEAL issued identity prior to accessing the service.

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Registration section. However, a generic SP for demo purposes is available at :
<https://dss1.aegean.gr/isErasmus/SSI/verify?spId=051083yyyyza3>

2. The student is presented with a VC disclosure request.
3. The student presents their VC containing their UAegean myID Credential.
4. The Verification Service displays a confirmation message.
5. The SP receives a verification successful email.

3.9.2 UAegean SmartClass

Service flow

A) Registration (first time access attempt)

1. The user accesses the UAegean SmartClass Service.
2. The user tries to sign in using one of the three choices available:
 - a. their UAegean myLinkedID (linking their eIDAS and eduGAIN identity profiles)
 - b. their eIDAS eID.
 - c. LinkedIn.
3. The user authenticates using their UAegean myLinkedID.
4. The user may need to fill in some additional details.
5. The user is informed about the success of their registration application submission.
6. An administrator accepts or rejects the application based on the information given.
7. In case of acceptance, an email is sent to the user containing an invitation to the Microsoft Teams SmartClass.

B) Login (subsequent access attempts)

1. The user accesses the UAegean SmartClass Service.
2. The user signs in using one of the three choices available:
 - a. their UAegean myLinkedID.
 - b. their eIDAS eID.
 - c. LinkedIn.
3. The user authenticates using their UAegean myLinkedID
4. The Service verifies that the user is successfully registered and provides access to the restricted sections of the service.
5. The user selects a resource (Team or Group).
6. The user receives information about how to use the Microsoft Teams SmartClass and connects to the Team or Group.

3.9.3 UAegean Online Course on Cybersecurity

Service flow

1. The user accesses the UAegean Online Course on Cybersecurity Service.
2. The user fills in their email.
3. The user authenticates using their “myIDs” Credential.
4. The user receives instructions on how to access the Course in Microsoft Teams.
5. An email is sent to the user’s email containing an invitation to join the “e-Privacy and Cybersecurity: Technology and Policy issues” Course.

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3.9.4 UAegean Central Authentication Service (CAS)

Service flow

1. The user accesses the UAegean CAS service
2. The user is requested to authenticate either using their local University Credentials or using their “uAegean | myID”
3. The user clicks the Login with uAegean | myID button and is requested to provide the corresponding SEAL issued “UAegean myID” VC
4. The user satisfies the credential disclosure request using their SEAL issued UAegean myID card via their mobile wallet app
5. The user is successfully authenticated

3.10 University of Malaga

3.10.1 UMA Centralised Identity Authentication Service

Service flow

1. The user reaches a service in the University of Málaga (UMA).
2. The user selects SEAL “myIDs” as their authentication method.
3. The user is redirected to SEAL Identity Provider.
4. The SEAL Identity Provider manages the authentication flow.
5. The SEAL IdP authenticates the person.
6. The user gets redirected to the UMA service, authorized based on their imported attributes.
7. The User can now use the service.

3.10.2 UMA Identity self-provisioning Service

Service flow

1. The user accesses the UMA Identity self-provisioning Service.
2. The user tries to log in by selecting SEAL “myIDs” as their preferred authentication method.
3. The user is redirected to SEAL Identity Provider.
4. The SEAL Identity Provider manages the authentication flow.
5. The SEAL IdP authenticates the person.
6. The user gets redirected to the UMA Identity self-provisioning Service, authorized based on their imported attributes.
7. The user enrolls in the UMA Virtual Campus and their attributes are automatically added to the identity repository.

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4. Pre-production testing (automated)

The following section describes the testing methodology and the test cases that have been selected within the context of Task 5.4 - Pre-production level semi-automatic validation tests to improve the quality and efficiency of the test process. It also presents the execution of these tests with the use of a fully automated approach, based on the use of Katalon Studio, a freemium test automated application built on top of the testing automation open-sources frameworks, Selenium and Appium. Katalon Studio allows users to automate test scripts and run them across different browsers and operating systems while providing a specialized IDE interface for API, Web and Mobile testing.

4.1 Automated testing software

For the purposes of automated testing, the Katalon studio tool was used. Katalon simulates a user's actions while providing features for automated screenshots and creating test reports. It follows steps, predefined either by recording a user's actions or by scripting them manually. These series of tests were selected as the actions a user would normally do manually when accessing the service's functionality. The biggest benefit from automated testing is that it makes it easier to run multiple tests automatically and quickly (eventually periodically and continuously, in a predefined time scale). It also allows for larger test coverage across different web environments which should effectively interoperate to provide a consistent user experience. As is the case of a service integrated to a third-party network for user authentication and attribute retrieval.

The automated testing of the SEAL infrastructure was not a trivial task. Its testing requires the simulation of simultaneous flows on both a web browser and a mobile device, working together and depending on one another. Additionally, due to SEALs dependency on external sources (eIDAS, eduGAIN etc.) extensive error handling tests are required.

In order to simulate the user's mobile phone, for scanning a QR and saving a VC in their eWallet, the Appium framework was utilized. Appium is an open-source test automation framework for use with native, hybrid and mobile web apps. By combining Appium with Katalon the integration of the SSI wallet app (uPort) was made feasible and it was used to simulate the user's mobile based interactions with a service running in the browser (scanning of browser displayed QR codes and so on).

Finally, all tests executed fail-safe conditions to find, record and overcome errors to ensure the production readiness of the SEAL service.

Using Katalon, each Service's flow was divided into different test scenarios. For every test scenario, an automated Katalon test was created for checking and analyzing that specific case.

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4.2 Definition and preparation for the automated testing process

4.2.1 SEAL Identities Issuance Test Cases (automated testing)

Activity 5 has defined 12 critical tests (i.e. test cases) - 8 corresponding to the different Identities that can be issued by the SEAL Platform and 4 error handling issuance tests - that should automatically be executed:

Table 1 Pre-production issuance test cases

No	Test Name	Type of Test	Imported identities
1	TC1.1_myIDs-VC	myLinkedID VC Issuance	eIDAS / eduGAIN
2	TC1.2_myIDs-PDS	myLinkedID PDS Issuance	eIDAS / eduGAIN ⁹
3	TC2.1_eIDASeID-VC_loginFirst	myeIDAS-ID VC Issuance	eIDAS
4	TC2.2_eIDASeID-VC_SelectionFromList	myeIDAS-ID VC Issuance	eIDAS
5	TC2.3_eduGAIN-VC	myeduGAIN-ID VC Issuance	eduGAIN
6	TC3.1_eIDASeID-PDS_loginFirst	myeIDAS-ID PDS Issuance	eIDAS
7	TC3.2_eduGAIN-PDS	myeduGAIN-ID PDS Issuance	eduGAIN
8	TC3.3_Derived_Identifier	DerivedID Issuance	eIDAS
9	TC4.1_NO-VC_eIDAS	No VC issuance	n/a
10	TC4.2_NO-1_PDS	No PDS issuance	n/a
11	TC4.3_NO-2_PDS	No PDS issuance	n/a
12	TC4.4_NO-myIDs	No LinkedID VC issuance	n/a

The paths explored for each test case are shown below:

#1 TC1.1_myIDs-VC: LinkedID VC Issuance

Description	A successful LinkedID VC Issuance (containing user's eIDAS and eduGAIN user attributes)
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⁹ The testing of the issuance of the linked Identities eIDAS / eduGAIN and eMRTD / eduGAIN was conducted with real users as part of the SEAL Dashboard usability testing (see section 6.2).

Preconditions	The user has a valid eIDAS eID and has an affiliation with an Academic Institution connected to the eduGAIN network
Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web¹⁰) Dashboard starting page: 2. User clicks the SSI button 3. User clicks the uPort button and pairs their wallet 4. User clicks “Login” from the uPort app 5. User is redirected to the SEAL Dashboard 6. User clicks the “Issue Verifiable Credentials” button 7. User clicks the “eIDAS-eduGAIN” button and redirects to the Verifiable Credential Issuer 8. User clicks the “eIDAS” button and authenticates through eIDAS 9. User authentication is completed 10. User is redirected back to the SEAL Dashboard 11. User clicks the “Issue Verifiable Credentials” button 12. User clicks the “eIDAS-eduGAIN” button 13. User clicks the “eduGAIN” button and authenticates based on their Affiliated Institute 14. User authentication is completed 15. User redirects to the Verifiable Credential Issuer and clicks the “Issue” button 16. User is informed that their credential has been issued 17. The VC is sent to the user’s mobile wallet.
Result	User successfully issues their eIDAS and eduGAIN Linked identity and the VC is sent to their mobile wallet

#2 TC1.2_myIDs-PDS: LinkedID PDS Issuance

Description	A successful LinkedID PDS Issuance (containing user’s eIDAS and eduGAIN user attributes)
Preconditions	The user has a valid eIDAS eID and has an affiliation with an Academic Institution connected to the eduGAIN network.

¹⁰ Note that the testing of the SEAL Mobile Dashboard was conducted with real users as part of the SEAL Dashboard usability testing (see section 6.2).

Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the PDS button 3. User clicks the “Local PDS” button 4. User clicks the “Local File” button 5. User clicks the “Create new File” button 6. User gives a file name and password and clicks “Confirm” 7. User is redirected to the SEAL Dashboard 8. User clicks the "Retrieve Identity Data" button 9. User clicks the “eIDAS” button and authenticates through eIDAS 10. User authentication is completed 11. User is redirected back to the SEAL Dashboard 12. User clicks the "Retrieve Identity Data" button 13. User clicks the “eduGAIN” button and authenticates based on their Affiliated Institute 14. User authentication is completed 15. The user is redirected back to the SEAL Dashboard 16. The user clicks the “Identity reconciliation” button 17. The user presses “Auto” 18. User selects their two identities and clicks “Request” 19. User is redirected back to the SEAL Dashboard 20. User clicks “Manage identity data”, goes into the “Link request” tab and presses Resolve 21. The user goes back to the SEAL Dashboard 22. User clicks the PDS button 23. User clicks the “Local PDS” button 24. The PDS is downloaded to the user's device
Result	User successfully issues their eIDAS and eduGAIN Linked identity and stores it in a PDS

#3 TC2.1_eIDASeID-VC_loginFirst: eIDAS-ID VC Issuance

Description	A successful eIDAS-ID VC Issuance from SEAL session
Preconditions	The user has a valid eIDAS eID

Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the SSI button 3. User clicks the uPort button and pairs their wallet 4. User clicks “Login” from the uPort app 5. User is redirected to the SEAL Dashboard 6. User clicks the “Retrieve Identity Data” button 7. User clicks the “eIDAS” button and authenticates through eIDAS 8. User authentication is completed 9. User is redirected back to the SEAL Dashboard 10. User clicks the “Issue Verifiable Credentials” button 11. User clicks the “eIDAS” button 12. User clicks the “Issue” button and is informed that their credential has been issued 13. The VC is sent to the user’s mobile wallet.
Result	User successfully issues their eIDAS identity and the VC is sent to their mobile wallet

#4 TC2.2_eIDASeID-VC_SelectionFromList: eIDAS-ID VC Issuance

Description	A successful eIDAS-ID VC Issuance from VC issuer interface
Preconditions	The user has a valid eIDAS eID
Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the SSI button 3. User clicks the uPort button and pairs their wallet 4. User clicks “Login” from the uPort app 5. User is redirected to the SEAL Dashboard 6. User clicks the “Issue Verifiable Credentials” button 7. User clicks the “eIDAS” button and redirects to the Verifiable Credential Issuer 8. User clicks the “eIDAS” button and authenticates through eIDAS 9. User authentication is completed 10. User is redirected back to the SEAL Dashboard 11. User clicks the “Issue Verifiable Credentials” button 12. User clicks the “eIDAS” button 13. User clicks the “Issue” button and is informed that their credential has been issued 14. The VC is sent to the user’s mobile wallet.

Result	User successfully imports their eIDAS identity and the VC is sent to their mobile wallet
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#5 TC2.3_eduGAIN-VC: eduGAIN-ID VC Issuance

Description	A successful eduGAIN-ID VC Issuance
Preconditions	The user has an affiliation with an Academic Institution connected to the eduGAIN network
Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the SSI button 3. User clicks the uPort button and pairs their wallet 4. User clicks “Login” from the uPort app 5. User is redirected to the SEAL Dashboard 6. User clicks the “Retrieve Identity Data” button 7. User clicks the “eduGAIN” button and authenticates based on their Affiliated Institute 8. User authentication is completed 9. User is redirected back to the SEAL Dashboard 10. User clicks the “Issue Verifiable Credentials” button 11. User clicks the “eduGAIN” button 12. User clicks the “Issue” button and is informed that their credential has been issued 13. The VC is sent to the user’s mobile wallet.
Result	User successfully issues their eduGAIN identity and the VC is sent to their mobile wallet

#6 TC3.1_eIDASeID-PDS_loginFirst: eIDAS-ID PDS Issuance

Description	A successful eIDAS-ID PDS Issuance
Preconditions	The user has a valid eIDAS eID

Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the PDS button 3. User clicks the “Local PDS” button 4. User clicks the “Local File” button 5. User clicks the “Create new File” button 6. User gives a file name and password and clicks “Confirm” 7. User is redirected to the SEAL Dashboard 8. User clicks the “Retrieve Identity Data” button 9. User clicks the “eIDAS” button and authenticates through eIDAS 10. User authentication is completed 11. User is redirected back to the SEAL Dashboard 12. User clicks the PDS button 13. User clicks the “Local PDS” button 14. The VC is sent to the user’s mobile wallet.
Result	User successfully imports their eIDAS identity and stores it in a PDS

#7 TC3.2_ eduGAIN-PDS: eduGAIN-ID PDS Issuance

Description	A successful eduGAIN-ID PDS Issuance
Preconditions	The user has an affiliation with an Academic Institution connected to the eduGAIN network
Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the PDS button 3. User clicks the “Local PDS” button 4. User clicks the “Local File” button 5. User clicks the “Create new File” button 6. User gives a file name and password and clicks “Confirm” 7. User is redirected to the SEAL Dashboard 8. User clicks the “Retrieve Identity Data” button 9. User clicks the “eduGAIN” button and authenticates based on their Affiliated Institute 10. User authentication is completed 11. User is redirected back to the SEAL Dashboard 12. User clicks the PDS button 13. User clicks the “Local PDS” button 14. The VC is sent to the user’s mobile wallet.
Result	User successfully imports their eduGAIN identity and stores it in a PDS

#8 TC3.3_Derived_Identifier: DerivedID Issuance

Description	A successful DerivedID Issuance
Preconditions	The user has a valid eIDAS eID
Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the SSI button 3. User clicks the uPort button and pairs their wallet 4. User clicks “Login” from the uPort app 5. User is redirected to the SEAL Dashboard 6. User clicks the "Retrieve Identity Data" button 7. User clicks the “eIDAS” button and authenticates through eIDAS 8. User authentication is completed 9. User is redirected back to the SEAL Dashboard 10. User clicks the “Derive Identifier” button 11. User clicks the “Manage Identity Data” button and finds their new Derived identity
Result	User derives a new identifier to their latest retrieved identity

#9 TC4.1_NO-VC_eIDAS: No VC issuance

Description	A unsuccessful eIDAS-ID VC Issuance
Preconditions	The user has a valid eIDAS eID
Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the SSI button 3. User clicks the uPort button and pairs their wallet 4. User clicks “Login” from the uPort app 5. User is redirected to the SEAL Dashboard 6. User clicks the “Retrieve Identity Data” button 7. User clicks the “eIDAS” button and tries to authenticate through eIDAS using an incorrect password 8. User authentication fails due to incorrect credentials and a specific eIDAS authentication fail page is shown (depending on user's country)
Result	The specific eIDAS authentication fail page is shown (depending on user's country)

#10 TC4.2_NO-1_PDS: No PDS issuance

Description	A unsuccessful PDS Issuance due to incorrect password
Preconditions	The user has a valid PDS
Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the PDS button 3. User clicks the “Local PDS” button 4. User clicks the “Local File” button 5. User clicks the “Load Existing File” button 6. User clicks the “Upload” button and chooses the SEAL file to be uploaded 7. The user fills the SEAL file's password incorrectly 8. The user presses “Confirm” and a “Your Password is Incorrect” message is shown
Result	User’s PDS fails to import and a “Your Password is Incorrect” message is shown

#11 TC4.3_NO-2_PDS: No PDS issuance

Description	A unsuccessful PDS Issuance due to corrupted SEAL PDS file
Preconditions	None
Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the PDS button 3. User clicks the “Local PDS” button 4. User clicks the “Local File” button 5. User clicks the “Load Existing File” button 6. The user clicks the "Upload" button and chooses a corrupted SEAL file to be uploaded 7. The user fills the SEAL file's password 8. The user presses “Confirm” and an “Invalid Signature” message is shown
Result	User’s PDS fails to import and an “Invalid Signature” message is shown

#12 TC4.4_NO-myIDs: No LinkedID VC issuance

Description	A unsuccessful LinkedID VC Issuance
Preconditions	The user uses a valid eIDAS eID and has an affiliation with an Academic Institution connected to the eduGAIN network but the attributes don't match between the two
Process	<ol style="list-style-type: none"> 1. User accesses the SEAL (Web) Dashboard starting page: 2. User clicks the SSI button 3. User clicks the uPort button and pairs their wallet 4. User clicks "Login" from the uPort app 5. User is redirected to the SEAL Dashboard 6. User clicks the "Issue Verifiable Credentials" button 7. User clicks the "eIDAS-eduGAIN" button and redirects to the Verifiable Credential Issuer 8. User clicks the "eIDAS" button and authenticates through eIDAS 9. User authentication is completed 10. User is redirected back to the SEAL Dashboard 11. User clicks the "Issue Verifiable Credentials" button 12. User clicks the "eIDAS-eduGAIN" button 13. User clicks the "eduGAIN" button and authenticates based on their Affiliated Institute 14. User authenticates with a different name account as the eIDAS one 15. User redirects to the Verifiable Credential Issuer and clicks the "Issue" button 16. A "VC issuance link failure" message is shown
Result	The Linked Issuance fails and a "VC issuance link failure" message is shown

4.2.2 SEAL Services Access Test Cases (automated testing)

Activity 5 has defined 2 characteristic service access tests corresponding to 2 SEAL HEI services - one consuming myLinkedID VC and another consuming myLinkedID PDS¹¹ - that are automatically executed and presented below:

¹¹ The rest of the services were not tested through automated tests in pre-production as they were available only in production. In any case the consumption of SEAL identities remains identical for the rest of the services which were all tested in the production environment.

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Table 2 Pre-production service access test cases

No	Test Name	Type of Test
1	TC1.1_UPorto_EWP_myIDs-PDS	Service access test using LinkedID PDS
2	TC1.2_UAegean_SmartClass_myIDs-VC	Service access test using LinkedID VC

The paths explored for each test case are shown below:

#1 TC1.1_UPorto_EWP_myIDs-PDS: Service access test using LinkedID PDS

Description	A successful user login to the UPorto EWP Portal using a LinkedID PDS
Preconditions	The user has a valid eIDAS eID and has an affiliation with an Academic Institution connected to the eduGAIN network The user holds a LinkedID PDS
Process	<ol style="list-style-type: none"> 1. User accesses uPorto EWP Portal starting page 2. User clicks the SEAL button 3. User is presented with the requested attributes and clicks "Personal Data Store" to satisfy the request 4. User clicks "Browser" 5. User clicks "Accept" 6. User clicks "Load Existing Data" button 7. User clicks the "Upload" button and chooses the SEAL file to be uploaded 8. User fills the SEAL file's password 9. User presses "Confirm" 10. The user's attributes are imported in the Service 11. User clicks "Accept", consenting to import their credentials 12. User clicks "Search for EWP Data" and the user's Mobility status is shown
Result	User successfully logs in to the Service and their Mobility status is shown

#2 TC1.2_UAegean_SmartClass_myIDs-VC: Service access test using LinkedID VC

Description	A successful user login to the UAegean Smart Class using a LinkedID VC
Preconditions	The user has a valid eIDAS eID and has an affiliation with an Academic Institution connected to the eduGAIN network The user holds a LinkedID VC
Process	<ol style="list-style-type: none"> 1. User accesses UAegean Smart Class starting page 2. User clicks the "Sign in" button 3. User clicks "Continue with UAegean myLinkedID" 4. User clicks the uPort button and pairs their wallet 5. User clicks "Login" from the uPort app 6. User logs in the Smart Class Service 7. User clicks the "Find an Online Class" button 8. User chooses the Seal Production Testing Group and joins it 9. User connects to the online classroom through Microsoft Teams
Result	User successfully logs in to the Service and connects to the online classroom through Microsoft Teams

4.3 Execution and documentation of automated tests

4.3.1 . SEAL Identities Issuance Test Cases (automated testing)

In more detail the tests defined in Section 4.2.1, with respect to the issuance of SEAL identities, together with a brief description for each test case are presented below.

Table 3 Identities issuance test cases (automated testing)

No	Service Name	Test Name	Test Description
1	SEAL Service (VC Issuer)	TC1.1_myIDs-VC	User accesses the SEAL Service in order to issue a Linked myIDs VC from the SEAL Dashboard

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2	SEAL Service (PDS)	TC1.2_myIDs-PDS	User accesses the SEAL Service in order to issue a Linked myIDs PDS
3	SEAL Service (VC Issuer)	TC2.1_eIDASeID-VC_loginFirst	User accesses the SEAL Service in order to import their eIDAS eID and then issue a VC
4	SEAL Service (VC Issuer)	TC2.2_eIDASeID-VC_SelectionFromList	User accesses the SEAL Service in order to issue an eIDAS VC
5	SEAL Service (VC Issuer)	TC2.3_eduGAIN-VC	User accesses the SEAL Service in order to issue an eduGAIN VC
6	SEAL Service (PDS)	TC3.1_eIDASeID-PDS_loginFirst	User accesses the SEAL Service in order to import their eIDAS eID and then store them in a PDS
7	SEAL Service (PDS)	TC3.2_eduGAIN-PDS	User accesses the SEAL Service in order to issue an eduGAIN PDS
8	SEAL Service (PDS)	TC3.3_Derived_Identifier	User accesses the SEAL Service and derives a new identifier for their latest retrieved identity
9	SEAL Service (VC Issuer)	TC4.1_NO-VC_eIDAS	User fails to authenticate via eIDAS eID
10	SEAL Service (PDS)	TC4.2_NO-1_PDS	User inputs wrong PDS credentials
11	SEAL Service (PDS)	TC4.3_NO-2_PDS	Non validated PDS file
12	SEAL Service (VC Issuer)	TC4.4_NO-myIDs	NoUser fails to provide matching identity profiles

For the execution of the aforementioned test cases, eIDAS eID and eduGAIN pre-production credentials were used as explained in the table below.

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Test Users (with test credentials):

User A	User B	User C	User D	User E
GR eIDAS eID Registered with UMA IdP	CY eIDAS eID Registered with UMA IdP	IT eIDAS eID Registered with UMA IdP	ES eIDAS eID Registered with UMA IdP	SI eIDAS eID Registered with UMA IdP

4.3.2 SEAL Services Access Test Cases (automated testing)

Similarly, the service access tests scenarios defined in Section 4.2.1, together with a brief description for each case are presented below:

Table 4 Service access test cases (automated testing)

No	Service Name	Test Name	Test Description
1	UPorto EWP Portal	TC1.1_UPorto_EWP_myIDs-PDS	User wants to access the uPorto EWP Service using their SEAL issued Linked myIDs PDS
2	UAegean-HP Smart Class Program	TC1.2_UAegean_SmartClass_myIDs-VC	User wants to access the UAegean-HP Smart Class Service using their SEAL issued Linked myIDs VC

Test Users (with test credentials):

Again, for the execution of the aforementioned test cases, eIDAS eID and eduGAIN pre-production credentials were used as explained in the table below.

User A	User B	User C	User D	User E
GR eIDAS eID Registered with UMA IdP	CY eIDAS eID Registered with UMA IdP	IT eIDAS eID Registered with UMA IdP	ES eIDAS eID Registered with UMA IdP	SI eIDAS eID Registered with UMA IdP

4.3.3 Automated Tests Execution Results

The automated test cases have been executed in repeated cycles with the use of Katalon studio, until all discovered issues have been resolved and all tests pass successfully.

A report summarizing the results of all test cases and providing a **complete testing report** per case (in pdf format) can be found in Annex.

See in particular, sheets (tabs):

1. Pre-Production Issuance Testing - columns O-S (Automated Test Report URL User A-User F)
2. Pre-Production SEAL Services Testing - columns O-S (Automated Test Report URL User A-User F)

Note that columns T and U (in both Pre-Production Issuance Testing and Pre-Production SEAL Services Testing tabs) include screenshots of the issued Verifiable Credentials and the issued PDS files.

Finally, let us mention here that a small number of test cases that could not be completed due to eIDAS connection issues at the time of writing this report are highlighted with grey colour.

In particular ES and CY eIDAS pre-production connections became unavailable during the last month of the testing period, affecting the following test cases: “TC1.2_UAegean_SmartClass_myIDs-VC” using CY, ES test credentials. The issue remained unresolved until this day.

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5. Production testing

The following sections present the preparation of the production tests and their execution results.

5.1 Definition and preparation for the production testing

For the production testing, the project has **recruited a number of real test-users** from different EU countries which tested “in-vivo” the proper function of the SEAL identities issuance as well as their consumption when accessing the SEAL HEI services.

5.1.1 SEAL identities issuance testing

The project has created instructions for testing the issuance of the SEAL identities in production, as per the following table, which can be found at the Annex.

Table 5 Instructions for issuing SEAL identities in production environment

#	Name of issued identity	VC/PDS	eIDAS/eduGAIN
1	my LinkedID VC	VC	eIDAS + eduGAIN
2	my LinkedID PDS	PDS	eIDAS + eduGAIN
3	myeIDAS-ID VC	VC	eIDAS
4	myeduGAIN-ID VC	VC	eduGAIN
5	myeIDAS-ID PDS	PDS	eIDAS
6	myeduGAIN-ID PDS	PDS	eduGAIN

5.1.2 SEAL services access testing

The project has created instructions for testing the SEAL HEI services in production, as per the following table, which can be found at the Annex.

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Table 6 Instructions for accessing SEAL HEI services in production environment

#	SP	Service Name	SEAL identity used for the test
1	UPorto (PT)	University of Porto EWP Service	my LinkedID PDS
2	UJI (ES)	UJI Personal Data Management Service	my LinkedID PDS
3	UAegean (GR)	UAegean myID Card	UAegean myID Card
4	UAegean (GR)	UAegean SmartClass	my LinkedID VC
5	UAegean (GR)	UAegean Online Course on Cyber Security	my LinkedID VC
6	UAegean (GR)	UAegean Central Authentication Service	my LinkedID VC
7	UMA (ES)	UMA Centralised Identity Authentication Service	my LinkedID PDS
8	UMA (ES)	UMA Identity self-provisioning Service	my LinkedID PDS

5.2 Production test cases

5.2.1 SEAL identities issuance testing (production testing)

The tests conducted from the real test users with respect to the issuance of SEAL identities, together with a brief description for each test case are presented below.¹²

Table 7 Identities issuance testing (production testing)

No	Service Name	Test Name	Test Description
1	SEAL Service (PDS)	TC1.1_myIDs-VC-PDS	User accesses the SEAL Service in order to issue a Linked myIDs VC and a Linked myIDs PDS
2	SEAL Service (VC Issuer)	TC2.1_eIDASeID-VC	User accesses the SEAL Service in order to retrieve their eIDAS eID and then issue a VC
3	SEAL Service (VC Issuer)	TC2.2_eduGAIN-VC	User accesses the SEAL Service in order to issue an eduGAIN VC
4	SEAL Service (PDS)	TC3.1_eIDAS-PDS	User accesses the SEAL Service in order to retrieve their eIDAS eID and then store them in a PDS
5	SEAL Service (PDS)	TC3.2_eduGAIN-PDS	User accesses the SEAL Service in order to retrieve their eduGAIN eID and then store it in a PDS

For the execution of the aforementioned test cases, eIDAS eID production credentials from 5 different EU countries were used, as explained in the table below:

Test Users with real eIDAS eID credentials:

User A	User B	User C	User D	User E
EE eIDAS eID Registered with UJI IdP	IT eIDAS eID Registered with UMA IdP	ES eIDAS eID Registered with UJI IdP	PT eIDAS eID Registered with UPorto IdP	DE eIDAS eID Registered with UMA IdP

¹² Note: Both the Web and Mobile dashboards were tested in production with real users as part of the usability testing (see section 6.2). In this testing the issuance of Linked (eIDAD/eMRTD and eduGAIN/eMRTD) PDS as well as the use of different SEAL PDS (local device, cloud) were tested.

5.2.2 SEAL services access testing (production testing)

The tests conducted from the real test users with respect to the access of the SEAL services in production environment, together with a brief description for each test case are presented below:

Table 8 Services access testing (production testing)

No	Service Name	Test Name	Test Description
1	UPorto EWP Portal	TC1.1_EWP	User wants to access the uPorto EWP Service using their SEAL issued Linked myIDs PDS
2	UJI Identity Module of the Student ERP	TC1.2_UJI	User wants to access the UJI Personal Data Management Service using their SEAL issued Linked myIDs PDS
3	UAegean ERASMUS myID Card	TC1.3_UAegean_myID_Card	User wants to issue a UAegean myID card and use it to prove their ERASMUS status
4	UAegean-HP Smart Class Program	TC1.4_UAegean_SC	User wants to access the UAegean-HP Smart Class Service using their SEAL issued myLinkedID
5	UAegean Online Course on Cybersecurity	TC1.5_UAegean_CS	User wants to access the UAegean Online course on cyber security using their SEAL issued myLinkedID
6	UAegean Central Authentication Service	TC1.6_UAegean_CAS	User wants to access the Central Authentication Service using their SEAL issued SEAL issued myLinkedID
7	UMA Centralised Identity Authentication Service	TC1.7_UMA_CIAS	User wants to access UMA's Centralised Identity Authentication Service using their SEAL issued Linked myIDs PDS

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8	UMA Identity self-provisioning service	TC1.8_UMA_ISS	User wants to access the Identity self-provisioning service from UMA using their SEAL issued Linked myIDs PDS
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For the execution of the aforementioned test cases, eIDAS eID production credentials from 5 different EU countries were used, as explained in the table below:

Test Users with real eIDAS eID credentials:

User A	User B	User C	User D	User E
EE eIDAS eID Registered with UJI	IT eIDAS eID Registered with UMA	ES eIDAS eID Registered with UJI	PT eIDAS eID Registered with UPorto	DE eIDAS eID Registered with UMA

5.2.3 Execution and documentation of production tests

The production test cases have been successfully executed, in two or three cycles, until the few discovered issues at this testing stage have been resolved.

A report summarizing the results of the production test cases and providing a **test folder per case** which includes all the screenshots the real test users have captured while issuing the SEAL identities and accessing the SEAL HEI services can be found in Annex.

See in particular, sheets (tabs):

3. Production Issuance Testing - columns P-T (Production Test Report URL Users A-E)
4. Production SEAL Services Testing - columns P-T (Production Test Report URL Users A-E)

Let us mention here that a small number of test cases that could not be completed due to eIDAS connection issues at the time of writing this report are highlighted with grey color.

In particular ES production connections became unavailable during the last month of the testing period, affecting the following test cases: “TC1.3_UAegean_myID_Card” ,”TC1.4_UAegean_SC”, “TC1.5_UAegean_CS” and “TC1.6_UAegean_CAS” using CY, ES test credentials. The issue remained unresolved until this day.

Additionally, the following test cases could not be completed due to UJI internal security restrictions for registering test users in their production identity management system: “TC1.2_UJI” using PT and DE users.

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6. Usability testing

This section presents the results of the usability testing performed to collect user feedback from real test user students who evaluated the functionality and usability of the results of the SEAL Project, as part of the task 5.5¹³ “Production testing, feedback collection, usability test”. The recruitment of the students contributed to the efforts of the task 5.3 “Students awareness campaign, recruitment for testing and SEAL Mobile App deployment and support”.

For the needs of the usability testing each partner was responsible for recruiting a set of students with the constraint that their country of origin would be connected to the Greek eIDAS node and that among the parameters at least five mobility students should be recruited. Those requirements aside, the rest of the attributes of the testers (gender, age, cycle of studies etc.) was left completely random to ensure the best possible coverage.

In order to recruit the usability students each HEI partner conducted an internal “**Student Awareness Campaign**” which included internal demonstrations of the project and lectures to the students. This campaign resulted in the selection of 25 students, representing different EU countries (from the North and South of Europe) and Higher Education Institutions, as per the following table:

Table 9 SEAL usability experiment analysis group

#	Country of origin	Number of students
1	Estonia	3
2	Italy	1
3	Greece	7
4	Spain	9
5	Portugal	5

From the above test users, 5 were purposefully selected to be mobility users to better evaluate the applicability of SEAL in such contexts. The distribution of the mobility population can be seen in the following table:

¹³ This task will organize pools of real users that will test the functionality of the SEAL platform services in concrete cases to demonstrate the use of the federated identity with different identification requirements. Beyond the functionality of the SEAL platform services, this task will include usability tests to verify the user-friendliness and the extent to which the users’ expectations and attitudes are addressed. This feedback will be taken into account to further improve the usability of the platform. At least 20-30 students will test the platform, including at least 5 mobility students from other EU/EEN countries

Table 10 SEAL Mobility student's distribution

#	Country of origin	Number of students	University of Origin	Receiving Institution
1	Spain	1	UAM	University of Exeter
2	Estonia	3	Univ. of Tartu	University of Konstanz
5	Italy	1	Univ. of Messina	UAegean

The conducted usability testing has two parts:

1. A group of 25 students were recruited from the partner HEIs, and were tasked with testing the functionality of the SEAL platform services by using the SEAL platform to issue a Linked identity (using as its bases either eIDAS eID, eduGAIN or their local identity profile, depending on the availability) VC and then present it in order to access a HEI service (offered by the University of the Aegean). Another service could have been selected as well, as the selection of the service was not so important for the purposes of the experiment and greater importance was given to the issuance and consumption of the SEAL issued identities.
2. A subgroup of the above 25 students were specifically tasked with testing the functionality of the SEAL platform services by using the SEAL platform (Web and Mobile) to issue a Linked identity using diverse means of identification (eIDASn eduGAIN and eMRTD) and different means of PDS storage (local, browser, cloud).

The first part of the usability testing will be referred to as SEAL usability experiment testing while the second as SEAL Dashboard usability testing.

6.1 SEAL usability experiment testing

The 25 recruited students participated in a usability experiment for testing the issuance and use of the UAegean myID Card which is issued as a Verifiable Credential via the SEAL Platform and delivered to the ERASMUS+ students hosted by the University of the Aegean after their registration with the ERASMUS Application and Admission Service (AAS), and the acceptance of the submitted application from the University.

6.1.1 Definition and preparation for the SEAL usability experiment

The students were initially invited to participate in a Google classroom, in order to establish a direct communication channel with them and be confident that they will remain committed to the experiment.

Next, instead of being given step by step instructions on how to issue and use the UAegean myID card they were provided with the information and material a real ERASMUS+ student would have had at their disposal upon being accepted for a UAegean mobility project.

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Additionally, the experiment was designed in such a way that the participants would feel like real ERASMUS+ UAegean students and immerse themselves in their role. In this way the users were encouraged to have an active attitude during the testing and more importantly this experiment design ensures that the results received would be more reliable and useful.

The experiment was divided into 4 main parts, each of which corresponded to an assignment in the classroom which the students had to submit on a specific date together with feedback proving they had completed it, as follows:

- 1a) SEAL experiment: Welcome message and first steps**
- 1b) SEAL experiment: Verify your eIDAS or eduGAIN credentials**
- 2) SEAL experiment: Getting started**
- 3) SEAL experiment: Get your UAegean myID card and enjoy a shopping experience**
- 4) SEAL experiment: Give us your feedback**

Essentially, the first two parts were part of the **Students Awareness Campaign** and prepared the group of the 25 students participating in the SEAL Usability experiment for the third and main part of it, the issuance and use of the UAegean myID Card. This was followed by the fourth, also important, part of the experiment, the evaluation of the whole experience on the basis of a specific Questionnaire they had to complete after having issued the UAegean myID Card and used it in real conditions.

In particular, in **part 1a**, the students were welcomed and given an overview of the main experiment. They were also invited to join the online classroom. After all the students joined the classroom they were assigned with their first task.

Their first assignment (**part 1b**) was to test if their authentication credentials are working. For this they had to go through the authentication process with either eIDAS eID or their academic ID (via eduGAIN). In order to ensure the authentication was done successfully they had to submit a screenshot of the final screen of the process. Those students who completed the first assignment proceeded to the next one.

In the **second** assignment the students were asked to read the UAegean Practical Guide, a University leaflet that is usually delivered to prospective ERASMUS+ students.

They were also invited to read a small selection of online materials on Verifiable Credentials and how they can be used to protect privacy and improve user experience while accessing online and physical services.

Finally, they were prompted to download the uPort ID wallet app (freely available in the Apple Store and Google Play) which is the reference technology for issuing and verifying SEAL and UAegean Digital Credentials. To ensure that the installation of the Uport app was done successfully they were asked to submit a screenshot of their mobile phone.

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The **third** assignment corresponded to the main experiment and had two distinct phases:

1. UAegean myID Card: Issuance

First, the students were asked to visit the UAegean myID Card website related pages (UAegean myIDs - Get yourID Card¹⁴ and UAegean myIDs - Coffee Shop experience¹⁵) to find out some useful information about the Cards and their uses and claim the twinned version of UAegean myID Card, which include:

- A Disposable UAegean ID that can be used to prove their affiliation with UAegean (a context specific, time limited and anonymous Verifiable Credential - Disposable Yet Official Identity)
- The complete version of UAegean Identity Card that can be used to prove who they are, together with their affiliation with UAegean

The process of Card issuance involves a few screens to interact with, and the authentication of the students with either eIDAS eID or their academic ID (via eduGAIN), a process familiar to them from the previous assignment and the backchannel verification of the ERASMUS+ affiliation with UAegean.

2. UAegean myID Card: Consumption

After the issuance of their UAegean ID Card, the students were invited to visit again the UAegean myIDs - Coffee Shop experience web page and try a shopping experience offered to the UAegean ERASMUS+ students, in collaboration with the 44 Coffee Shop at Chios, conditional to the presentation of their ID Card with UAegean. This included a personalized “shopping gift” that will be delivered to them by mail (without being required to disclose any other identification information other than their UAegean affiliation and the address they want to receive their gift).

After the testing of the issuance and use of the UAegean myID Card, the students in their **fourth** assignment, were asked to fill out an end user survey/questionnaire (which can be found in the Annex) consisting of the following questions:

Table 11 Usability experiment end user survey’s questions

#	Question
1	The issuance process started from my PC and then by scanning the QR code, resumed to my mobile phone. Do you consider this an inconvenience (1: Inconvenient - 5: Convenient)?

¹⁴ <https://www.myids-i4mlab.aegean.gr/get-yourid-card>

¹⁵ <https://www.myids-i4mlab.aegean.gr/myid-card-cross-border-field-experiment-june-2021/coffee-shop-experience>

2	How complicated was it to issue yourID Card as a Verifiable Credential and store it in your mobile device (1: Complicated - 5: Simple)?
3	How complicated was it to prove your Erasmus status using your mobile-stored ID Card instead of simply presenting your paper-based Student Identity card (1: Complicated - 5: Simple)?
4	Do you prefer to use yourID Card over other electronic means of Identification, like University username and password (1: Inconvenient - 5: Convenient)?
5	Do you think using yourID Card to access an online service (eventually anonymously), such as the "44 Coffee Store " web shopping page, was a straightforward process or an unnecessarily complex one (1: Straightforward - 5: Unnecessarily complex)?
6	How different do you consider yourID Card as Verifiable Credential stored in your mobile wallet, compared to a mobile boarding pass card - usually provided by airline companies when traveling (1: Not essentially different - 5: Very different)?
7	How complex was the issuance and use of yourID Card compared to a mobile boarding pass card - usually provided by airline companies when traveling (1:Very Complex - 5: Easy to handle)?
8	The UAegean myID Card however is an identity bound to each of the students and cannot be shared/copied/stolen, in contrast with a simple boarding pass. How clear do you find this distinction (1: Unclear - 5: Clear):
9	Having in mind the increased level of security it provides and the fact that the issuance is only performed once, how would you rate the myID Card overall experience (1: Non pleasant - 5: Satisfactory)?
10	Would you like to use yourID Card in other circumstances as well, inside and outside of the University Campus, such as: <ul style="list-style-type: none"> ● University library ● Transport means ● Other, please specify:
11	I think the UAegean myID Card could be improved by:

In questions 1-9 students were asked to answer each question/statement with a score from 1-5. Question 10 is a multiple choice question and in the last question students were asked to give a long answer.

6.1.2 . SEAL usability experiment evaluation

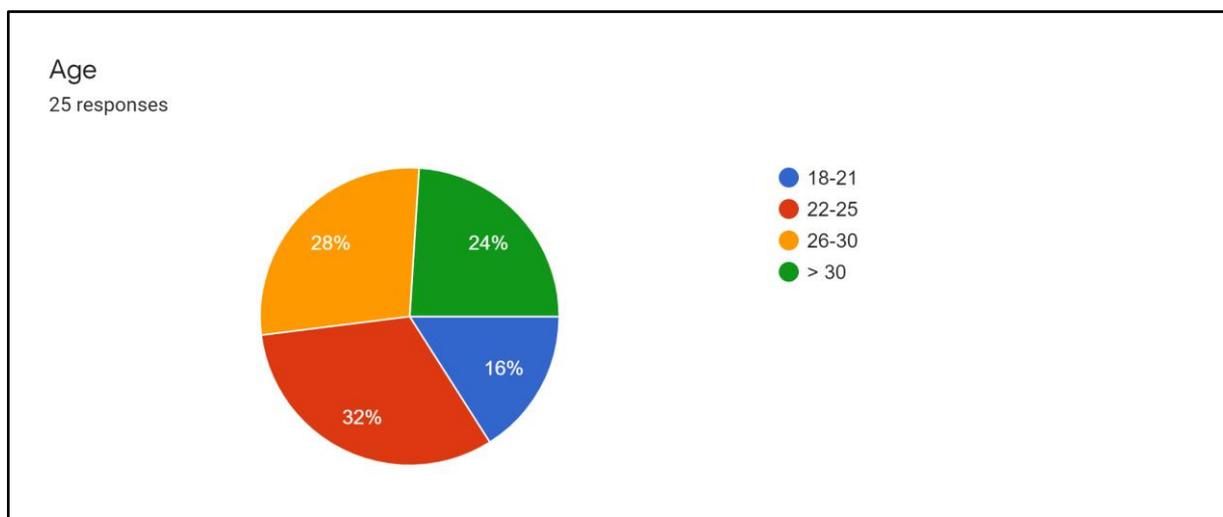
In general, the students participated actively in the experiment, completed successfully their assigned tasks, and showed interest in the new technologies they tested even though they had to repeat some parts of the processes.

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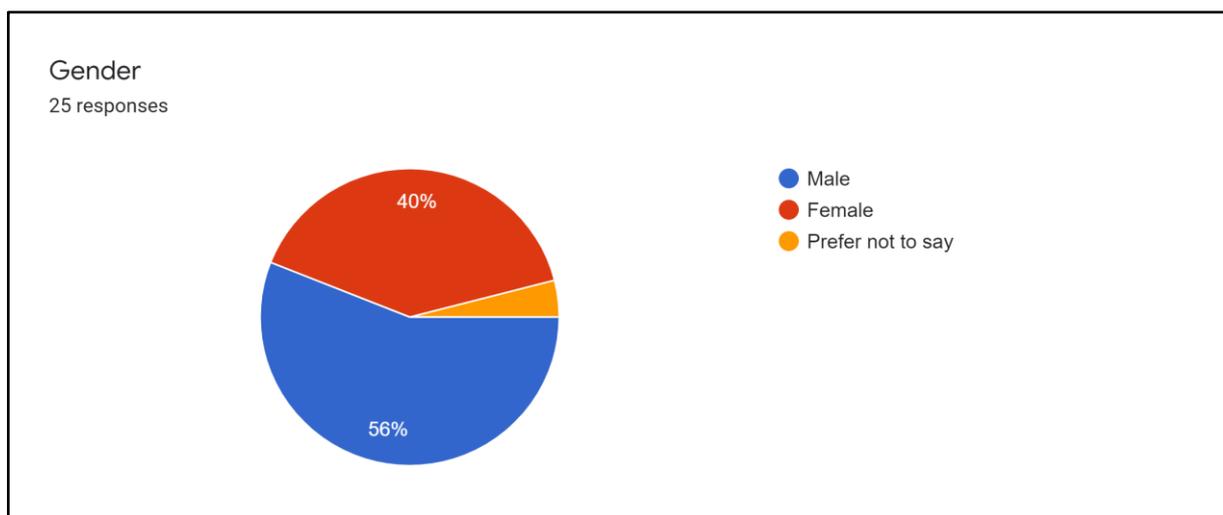
A **report** summarizing the results of the SEAL usability experiment and presenting in detail the test plan, the difficulties encountered by the students during the issuance and use of the UAegean myID Card, their overall performance and the solutions used to deal with the identified issues, can be found at the Annex.

The distribution of the **end user survey's** responses obtained from the SEAL usability experiment analysis group are presented below.

In particular, the following diagram summarizes the **age** distribution of the test subjects of the SEAL usability experiment analysis group.

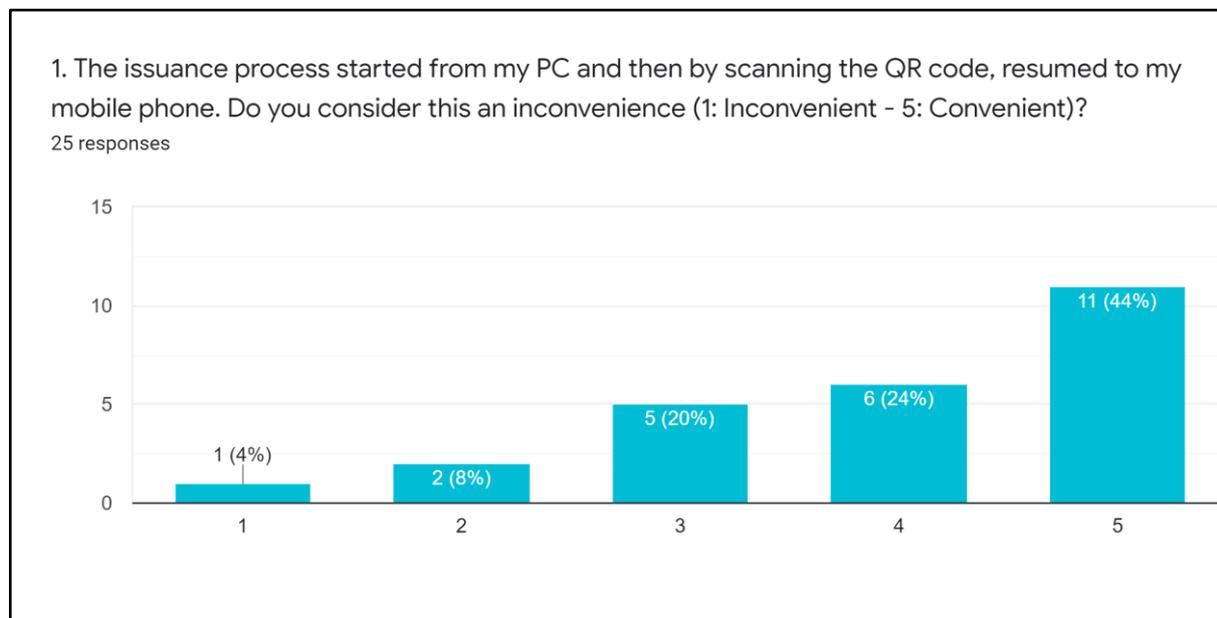


In the diagram below the **gender** distribution of the test subjects of the SEAL usability experiment analysis group is presented.

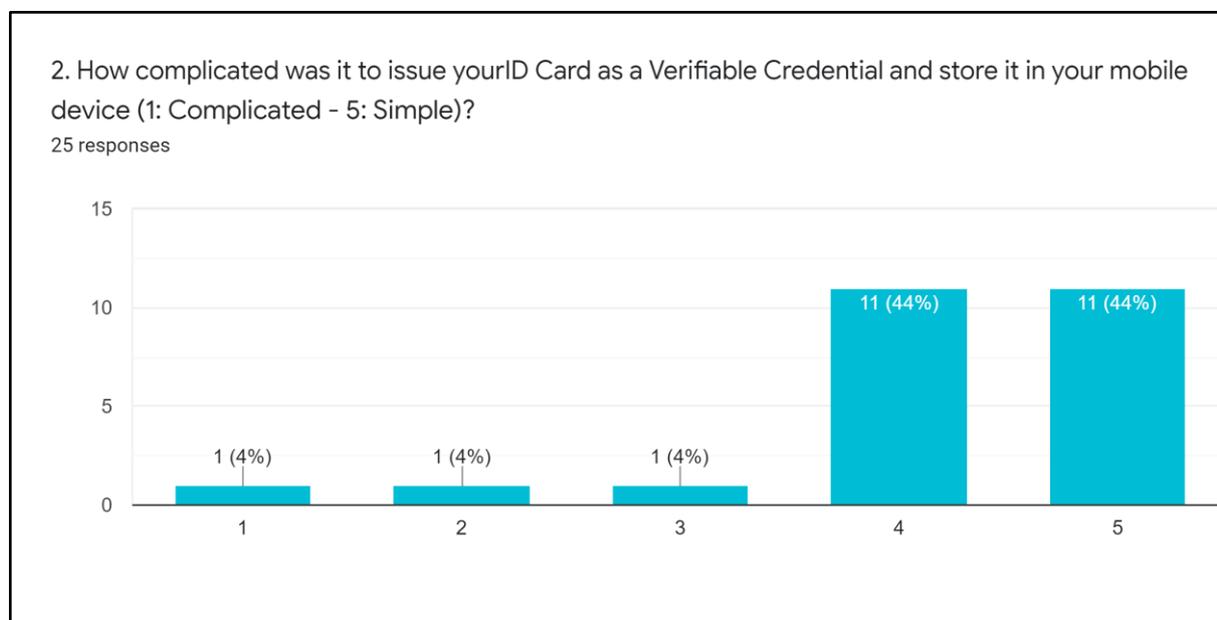


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In the next diagram, the distribution of the scores of the SEAL usability experiment analysis group regarding the **1st question** are presented.



The following diagram presents the distribution of the scores of the SEAL usability experiment analysis group regarding **question 2**.

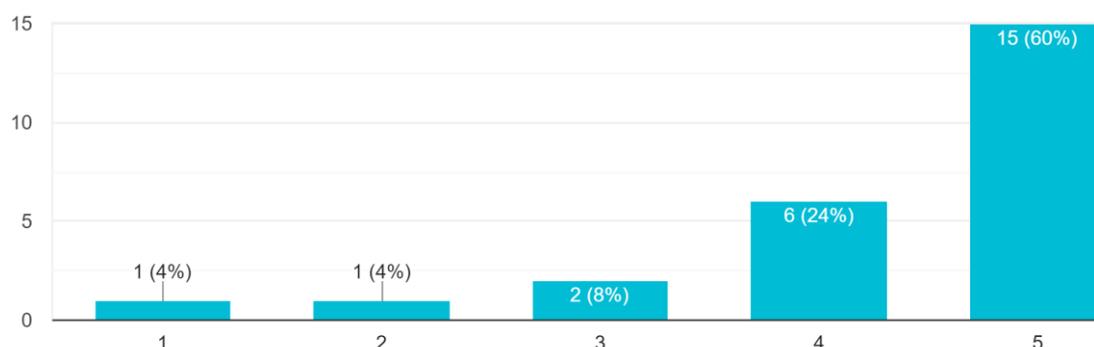


The diagram below summarizes the distribution of the scores of the SEAL usability experiment analysis group regarding **question 3**.

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3. How complicated was it to prove your Erasmus status using your mobile-stored ID Card instead of simply presenting your paper-based Student Identity card (1: Complicated - 5: Simple)?

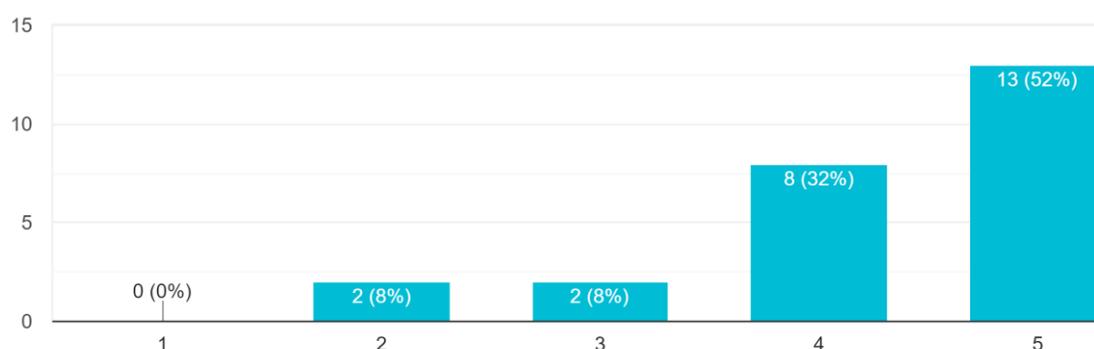
25 responses



In the next diagram, we can see the distribution of the scores of the SEAL usability experiment analysis group regarding the **4th question**.

4. Do you prefer to use yourID Card over other electronic means of Identification, like University username and password (1: Inconvenient - 5: Convenient)?

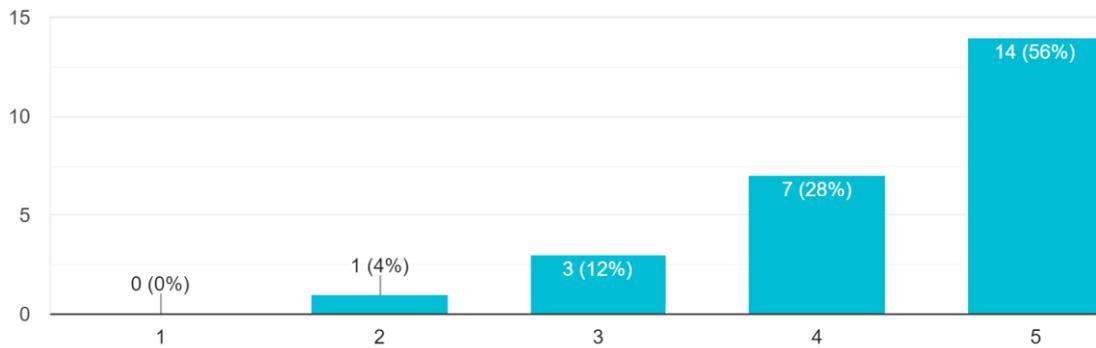
25 responses



The following diagram presents the distribution of the scores of the SEAL usability experiment analysis group regarding **question 5**.

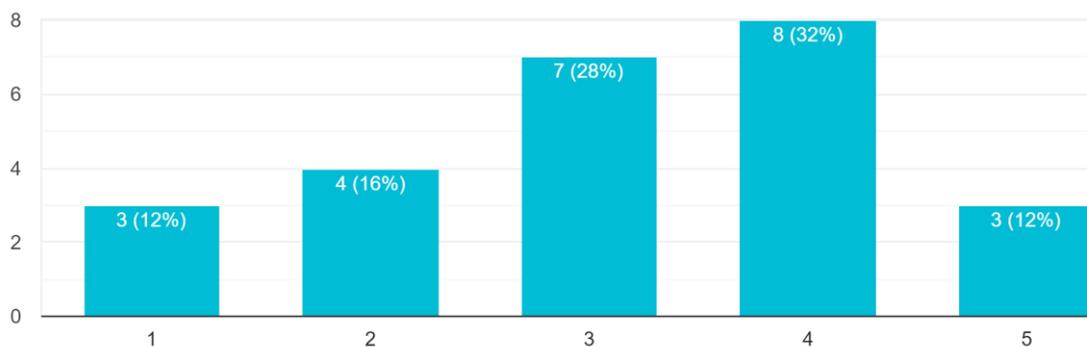
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				Status:	Final

5. Do you think using yourID Card to access an online service (eventually anonymously), such as the "44 Coffee Store " web shopping page, was an ...e (1: Unnecessarily complex - 5: Straightforward)?
25 responses



In the diagram below, the scores for the **6th question** of the SEAL usability experiment analysis group are presented.

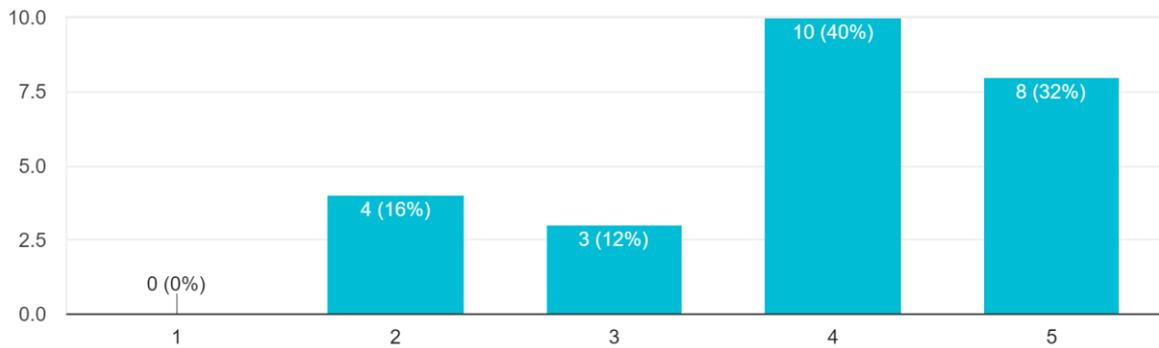
6. How different do you consider yourID Card as Verifiable Credential stored in your mobile wallet, compared to a mobile boarding pass card - usually pr... (1: Very different - 5: Not essentially different)?
25 responses



The following diagram contains the distribution of the scores of the SEAL usability experiment analysis group regarding the **7th question**.

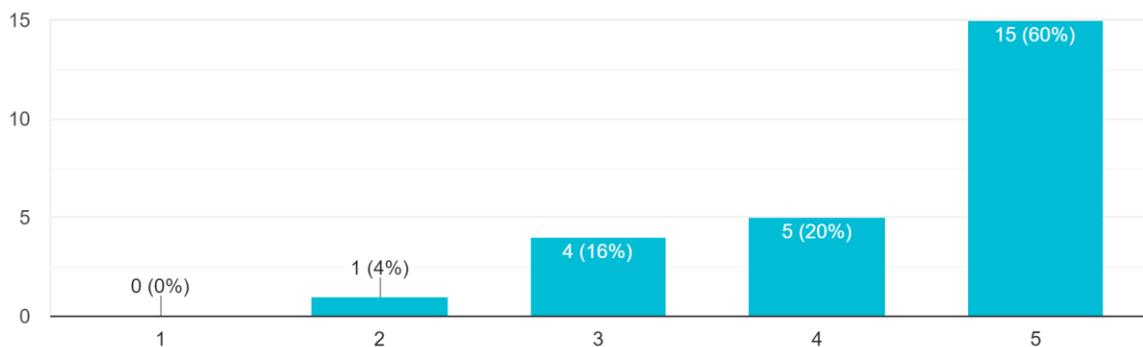
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7. How complex was the issuance and use of yourID Card compared to a mobile boarding pass card - usually provided by airline companies when traveling (1: Very Complex - 5: Easy to handle)?
25 responses



Following the distribution of the scores of the SEAL usability experiment analysis group regarding **question 8** is presented.

8. The UAegean myID Card however is an identity bound to you and cannot be shared/copied/stolen, in contrast with a simple board...o you find this distinction (1: Unclear - 5: Clear)?
25 responses

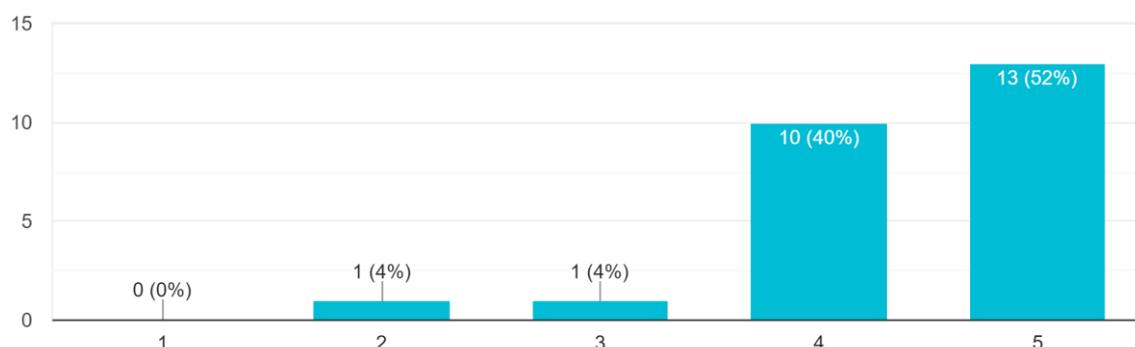


The next diagram summarizes the distribution of the scores of the SEAL usability experiment analysis group regarding **question 9**.

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9. Having in mind the increased level of security it provides and the fact that the issuance is only performed once, how would you rate the myID Card ...l experience (1: Non pleasant - 5: Satisfactory)?

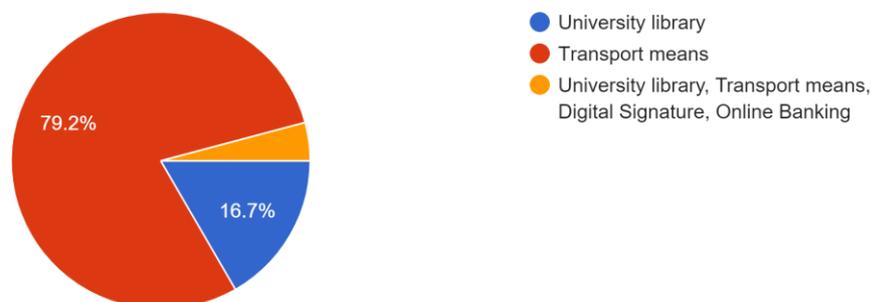
25 responses



In the following diagram, we can see the distribution of the scores of the SEAL usability experiment analysis group regarding the **10th question**.

10. Would you like to use yourID Card in other circumstances as well, inside and outside of the University Campus, such as:

24 responses



Finally, the suggestions of the students on how to improve the myID Card service (**question 11**) can be summarized as follows:

- Reduce the number of authentication steps needed to issue the myID card
- Improve the compression and readability of the generated QR codes
- Improve the overall design of the User Interfaces (fonts, sizes, etc.)
- Improve the notification of the user with respect to which data are contained within the VC that is being requested to access the service
- Expand on the provided details about the issuance and usage of the myID Card

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6.1.3 SEAL usability experiment result analysis

The responses obtained from the SEAL usability experiment analysis group can be found at the Annex. Their **main statistical** results are presented below:

Table 12 Main statistical results of the SEAL usability experiment analysis group

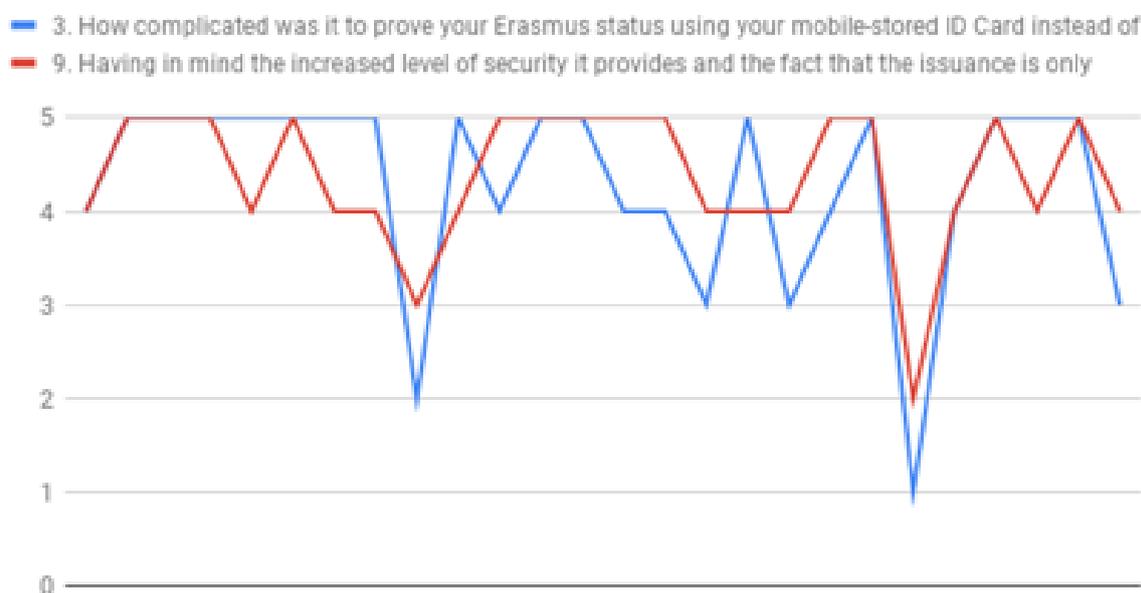
Country	Age	Gender	Q1
Estonia: 3 Greece: 7 Italy: 1 Portugal: 5 Spain: 9	18-21:5 22-25:8 26-30:7 > 30 :5	Female :10 Male :14 Prefer not to say: 1	Min. :1.000 1st Qu.:3.000 Median :4.000 Mean :3.885 3rd Qu.:5.000 Max. :5.000
Q2	Q3	Q4	Q5
Min. :1.000 1st Qu.:4.000 Median :4.000 Mean :4.192 3rd Qu.:5.000 Max. :5.000	Min. :1.000 1st Qu.:4.000 Median :5.000 Mean :4.269 3rd Qu.:5.000 Max. :5.000	Min. :2.000 1st Qu.:4.000 Median :4.500 Mean :4.269 3rd Qu.:5.000 Max. :5.000	Min. :2.000 1st Qu.:4.000 Median :5.000 Mean :4.346 3rd Qu.:5.000 Max. :5.000
Q6	Q7	Q8	Q9
Min. :1.000 1st Qu.:2.250 Median :3.000 Mean :3.154 3rd Qu.:4.000 Max. :5.000	Min. :2.000 1st Qu.:3.000 Median :4.000 Mean :3.846 3rd Qu.:5.000 Max. :5.000	Min. :2.000 1st Qu.:4.000 Median :5.000 Mean :4.346 3rd Qu.:5.000 Max. :5.000	Min. :2.000 1st Qu.:4.000 Median :4.500 Mean :4.385 3rd Qu.:5.000 Max. :5.000

Summarizing here, most of the students consider the process of issuing their ID Card (although they used both their PC and mobile devices) convenient. Additionally, the majority of the students found the issuance of their ID Card¹⁶ a simple process and its usage to access an online service straightforward.

Furthermore, most of them indicated that they prefer to use their ID Cards instead of their University credentials (username and password) and believe that proving their ERASMUS+ status using their mobile-stored VC is simpler than using their paper-based University Card.

¹⁶ as a Verifiable Credential and its storage in their mobile.

Correlation of questions 3 and 9



This result denotes that the users are willing to sacrifice simplicity for better security. However this tradeoff can only take place to some extent as simplicity was discovered to be the key factor with respect to the users' satisfaction with the service.

Additionally, as expected, a correlation between the perceived complexity of the issuance of their ID Card as a VC (**Q2**) and the perceived complexity of proving their Erasmus status using their mobile-stored ID Card instead of their Student Identity card (**Q3**) was detected with a positive coefficient of 0.6673055503.

Likewise, a correlation was also found between the students' rating of the overall myID Card experience while having in mind the increased level of security it provides and the fact that the issuance is only performed once (**Q9**) and the perceived complexity of accessing an online service using their ID Card (**Q5**), with a correlation coefficient of 0.6623692723, which is also expected.

In addition, we concluded that there exists significant correlation between the **age** of the students and the responses in **Q2**: how complicated is to issue yourID Card as a Verifiable Credential and store it in your mobile device (1: Complicated - 5: Simple) with a negative correlation coefficient¹⁷ of -0.9812331.

This means that younger students perceive the issuance of their ID Card simpler, which is something expected if we take into account that Gen Y are used to doing business over their phone and their PC.

¹⁷ The Pearson product-moment correlation coefficient is a statistical measurement of the correlation (linear association) between two sets of values.

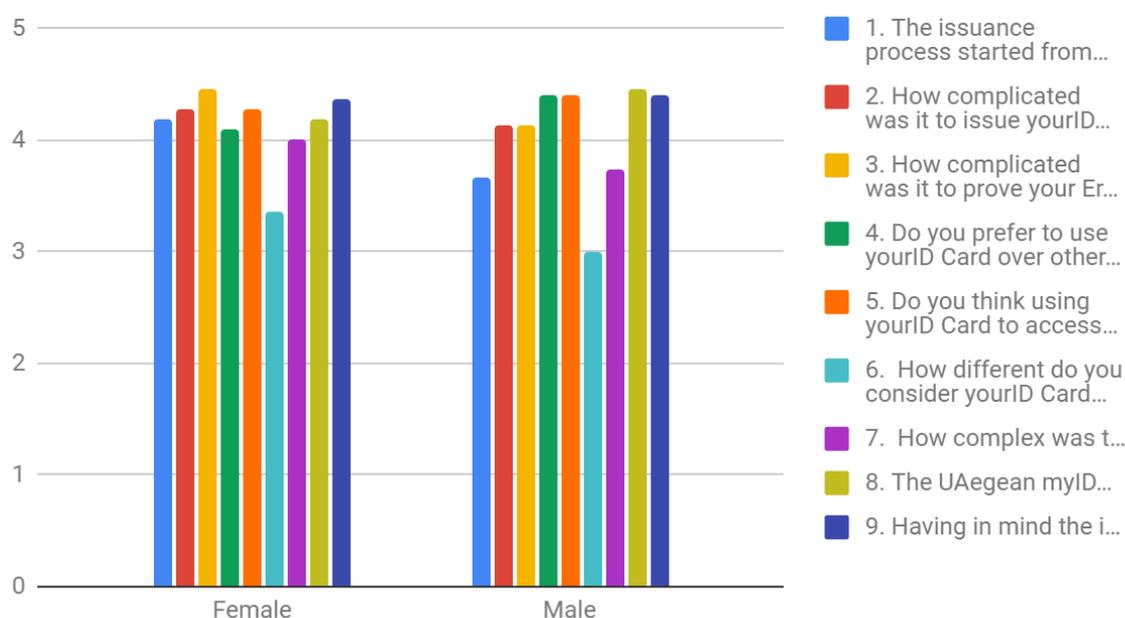
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We also concluded that there exists significant correlation between the **age** of the students and the responses in **Q8**: How clear is the distinction between the UAegean myID Card and a simple boarding pass with respect to security, with a negative correlation coefficient of -0.8609563.

This means that younger students find this distinction clearer, a promising result indicating that younger generations are more aware of matters of privacy and security in the online world.

Additionally, the following graph provides a visual representation of the **aggregated** scores of the SEAL usability experiment based on the user's **gender**. Based on this we can see that there is **no significant deviation** in the overall score depending on the gender of the users.

Aggregated responses based on student's gender

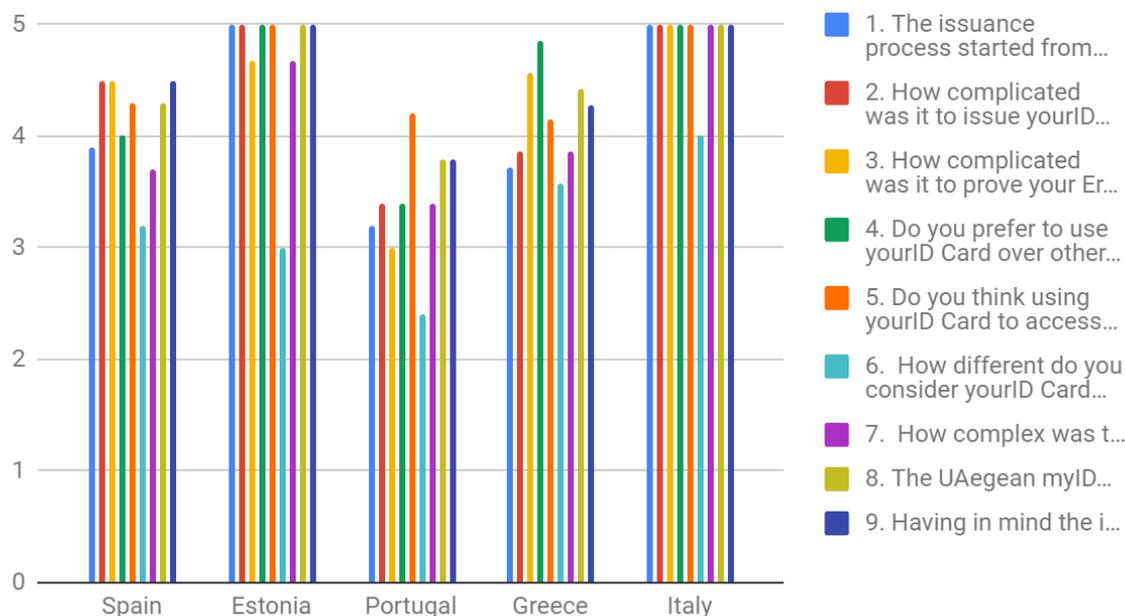


Finally, the following graph provides a visual representation of the **aggregated** scores of the SEAL usability experiment based on the user's **country** of origin. Based on this, SEAL's overall score was

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the highest for the students originating from Italy and Estonia.

Aggregated responses based on student's country



This result can be justified in a twofold manner. Firstly, users from Estonia and Italy have a strong eID culture (both being pioneering countries in eID adoption^{18,19}). Second, the students originating from these countries in the usability analysis group were **mobility** students, who are typically more accustomed to accessing cross-border University online services.

No significant correlation between the responses of the remaining questions were concluded.

¹⁸ Digital Government Factsheet Estonia (europa.eu): https://joinup.ec.europa.eu/sites/default/files/inline-files/Digital_Government_Factsheets_Estonia_2019.pdf

¹⁹ SPID on high speed: State of Play on Digital Identity in Italy: <https://www.namirial.com/en/namirial-sp-id-digital-identity-electronic-identity-eid-italy-state-of-play-jan-2021/>

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6.2 SEAL Dashboard Usability Testing

A subgroup of the SEAL usability experiment analysis group, consisting of 6 students, tested the usability of the SEAL platform (Web²⁰ and Mobile²¹), as per the the following table:

Table 13 SEAL Dashboard usability experiment analysis group

#	Country of origin	Number of students
1	Estonia	1
2	Greece	2
3	Spain	3

6.2.1 Definition and preparation for the SEAL Dashboard usability testing

The SEAL Dashboard usability testing was divided into 2 main parts - and associated assignments -, one for testing the functionality and usability of the SEAL Web Dashboard and another for testing the SEAL Mobile Dashboard:

1. Issue your Linked-ID (eIDAS / eduGAIN) PDS via the SEAL Web Dashboard
2. Issue your Linked-ID (eIDAS or eduGAIN / eMRTD) PDS via the SEAL Mobile Dashboard

In the first assignment the students were asked to visit the SEAL Web Dashboard in order to retrieve their **eIDAS** and their **eduGAIN** (academic) attributes, link their two identities and store them as a PDS file using different means of PDS storage (local, browser, cloud).

In the second assignment the students were first prompted to download the SEAL Mobile app and the SEAL eMRTD Reader (also part of the **Students Awareness Campaign**). Next they were asked to access the SEAL App in order to retrieve their **eIDAS or eduGAIN** (academic) attributes and their **eMRTD** data (authentication using either their National ID or their Passport), link their two identities and store them as a PDS file using different means of PDS storage.

A hint was provided to them with more details on the linking of their identities. Finally, they were asked to submit their linked PDS file (since it cannot be used/opened by a third person without having the password of the PDS file) as a proof of the completion of the assignments.

²⁰ <https://seal.uma.es/dashboard/>

²¹ <https://play.google.com/store/apps/details?id=eu.atos.atosreader>
<https://play.google.com/store/apps/details?id=uma.dev.seal.app>

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After completing the testing of the SEAL Web and Mobile Dashboard, the students were asked to fill out an end user survey/questionnaire²², consisting of the following questions:

#	Question
1	How complicated was it to retrieve your attributes using the SEAL Dashboard (1: Complicated - 5: Simple)?
2	How complicated was it to link your identities and save it as a PDS file in your device (1: Complicated - 5: Simple)?
3	How long did it take you to accomplish the tasks of issuing your LinkedID and storing it as a PDS file (1: Very long, 5: Not long)?
4	During the automated linking of your identities, did you have to use the hint in order to complete the process?
5	Did you test the Web or the Mobile SEAL Dashboard?
6	How intuitive would you rate the SEAL Dashboard interface (1: Intuitive - 5: Difficult to use)?
7	I think the SEAL Dashboard could be improved by:

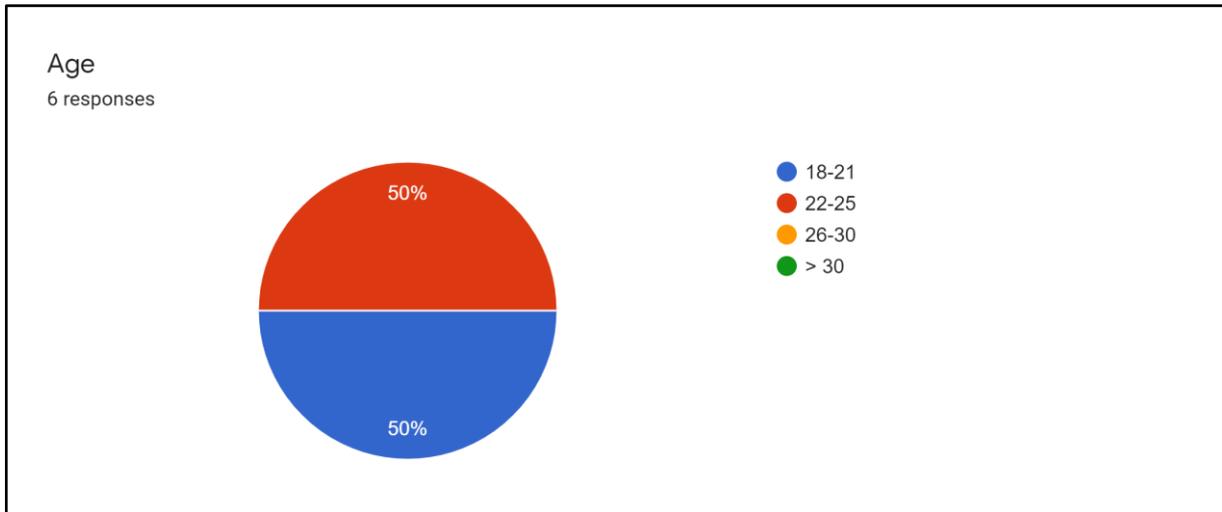
In questions 1-4 and 5 students were asked to answer each question/statement with a score from 1-5. Question 5 is a multiple-choice question and in the last question students were asked to give a long answer.

6.2.2 SEAL Dashboard usability testing evaluation

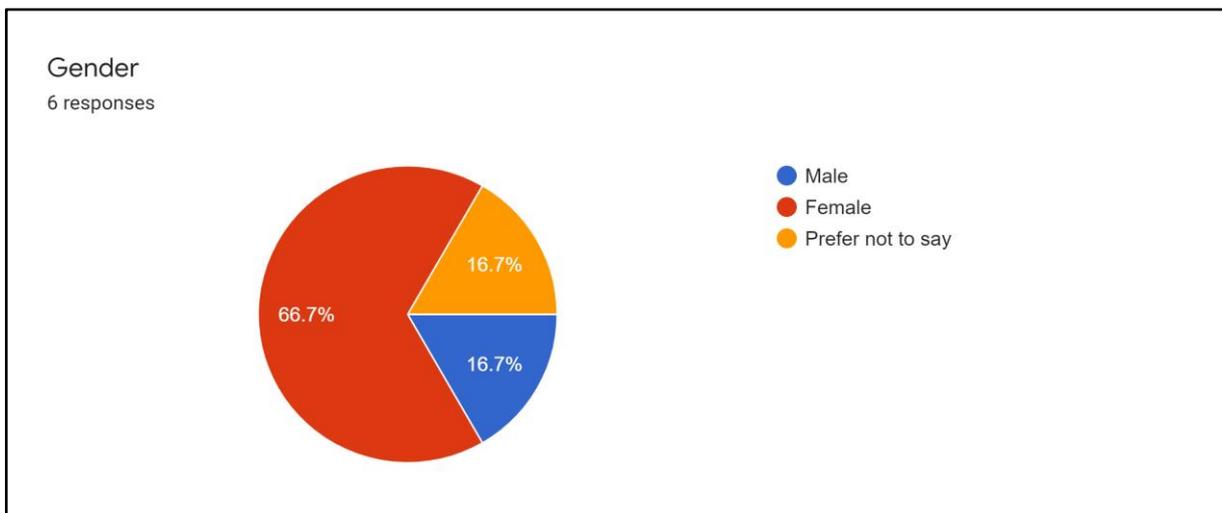
The distribution of the **end user survey's** responses obtained from the SEAL Dashboard usability analysis group is presented below.

In particular, the following diagram summarizes the **age** distribution of the test subjects of the SEAL Dashboard usability analysis group:

²²https://docs.google.com/forms/d/e/1FAIpQLSe7fQ5cO0NYdney5arpXSfAWbxbRviavykhJCCwx6w4_Xb7ZA/viewform?usp=sf_link



In the following diagram the **gender** distribution of the test subjects of the SEAL Dashboard usability analysis group is presented.

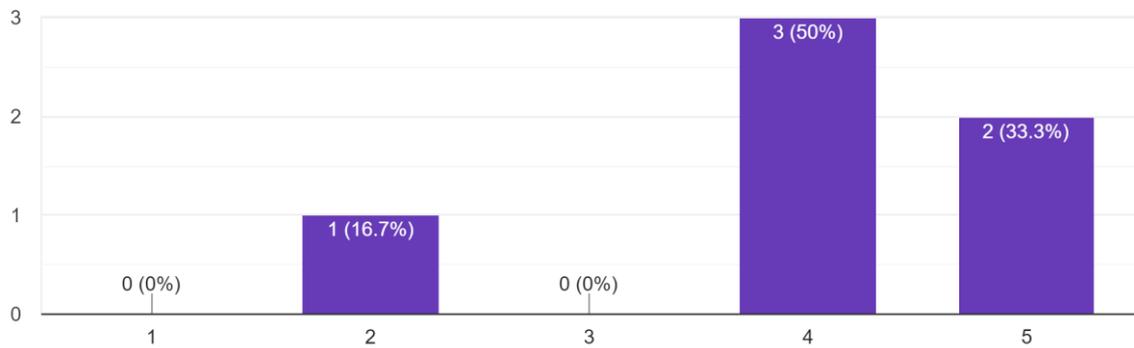


In the next diagram, we can see the distribution of the scores of the SEAL Dashboard usability analysis group regarding the **1st question**.

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1. How complicated was it to retrieve your attributes using the SEAL Dashboard (1: Complicated - 5: Simple)?

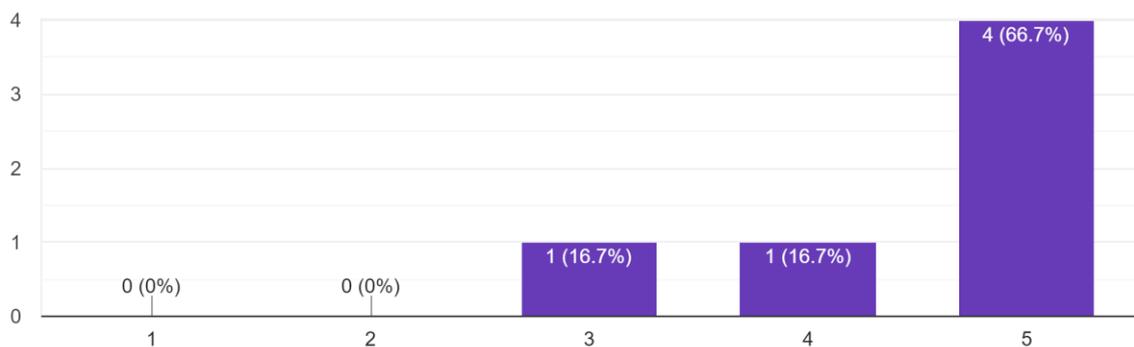
6 responses



Below the distribution of the scores of the SEAL Dashboard usability analysis group regarding **question 2** is presented.

2. How complicated was it to link you identities and save it as a PDS file in your device (1: Complicated - 5: Simple)?

6 responses

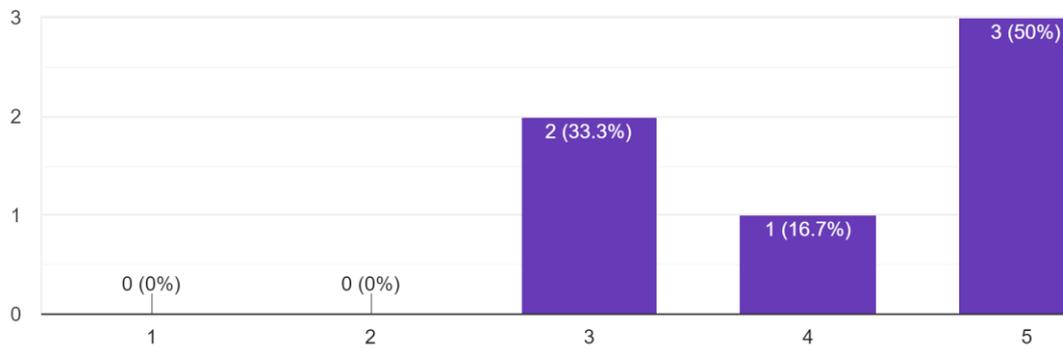


The diagram below summarizes the distribution of the scores of the SEAL Dashboard usability analysis group regarding **question 3**.

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3. How long did it take you to accomplish the tasks of issuing your LinkedID and storing it as a PDS file (1: Very long, 5: Not long)?

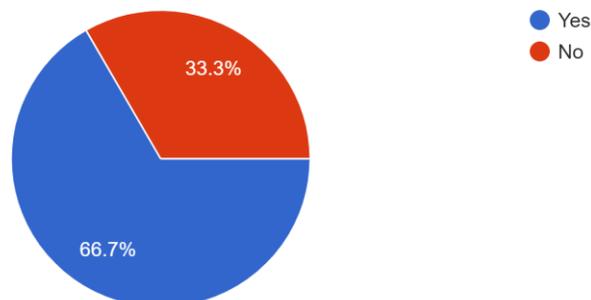
6 responses



In the next diagram, we can see the distribution of the scores of the SEAL Dashboard usability analysis group regarding the **4th question**.

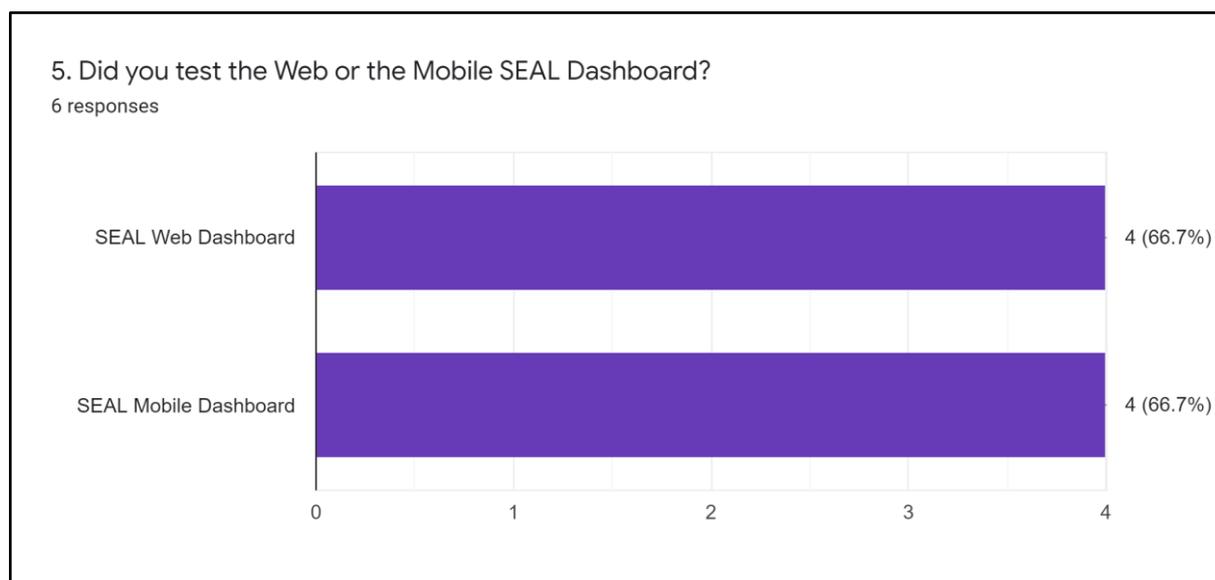
4. During the automated linking of your identities, did you have to use the hint in order to complete the process?

6 responses

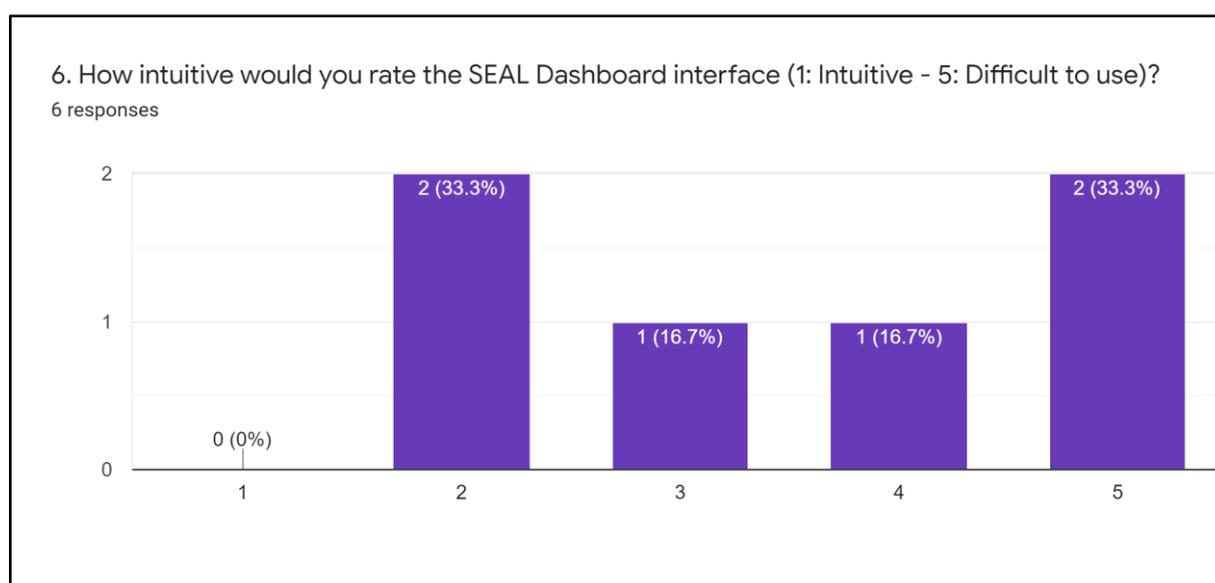


Below the distribution of the scores of the SEAL Dashboard usability analysis group regarding **question 5** is presented.

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In the diagram below, we see the distribution of the scores for the **6th question** of the SEAL Dashboard usability analysis group.



Finally, the suggestions of the students on how to improve the SEAL Dashboard (last question) can be summarized as follows:

- Simplify and make more intuitive the interfaces of the Dashboard
- Improve the ePassport reader functionality as the current version suffers from stability issues making it difficult to import eMRTD attributes
- Automate the storage of the attributes to the PDS or notify the user that they must manually decide to save their imported attributes to the PDS storage.

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Summarizing here, most of the students consider the process of retrieving their attributes, linking them and storing their linked identity as a PDS, simple and short in time. Most of them however used the hint on how to link their identities that contained step by step instructions. This aligns with the fact that most of the students find the interface of SEAL Dashboard moderately complex.

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7. Conclusion

This deliverable reported on the status and results of the testing processes aimed to prove the correct and efficient operation of the SEAL Platform and the SEAL HEI services integrated with it. Specifically, two types of test were conducted:

- **Functional:** automated and manual tests that verified the correct functional implementation of the SEAL service using both test/pre-production eIDAS eID credentials (for the automated tests) and real/production eIDAS eID credentials from cross-border users recruited from five different member states (cross-border with respect to the Greek eIDAS node that offers the eIDAS eID connectivity to the SEAL infrastructure).
- **Usability:** manual tests conducted by recruited test users that evaluated the final result of SEAL, from a user experience perspective, and provided valuable feedback both for the future adoption of the SEAL infrastructure as well as possible future improvements that must be made in order to ensure SEALs uptake.

Concluding, we report that the functional tests (both automated and production) were completed successfully, despite the difficulties encountered mostly regarding the connection of several eIDAS nodes, thus proving the proper function of the SEAL Platform and the SEAL HEI services.

Furthermore, the performed usability tests showed a positive response from users on the key aspects of the SEAL infrastructure, i.e. decentralization, user-centricity and identity linking, as well as a pleasant user experience (comparable to that of using an airline boarding pass). Of course, potential improvements were suggested such as the simplification of the linking interfaces and the retrieval of the user attributes from the authoritative sources. However, the overall feedback was positive and it is indicative that the vast majority of the testers stated that they would like to see SEAL rolled out in other contexts (like transportation).

Finally, based on the usability testing analysis conducted we concluded that on one hand, young students perceive the issuance of their ID Card simple enough while at the same time understand its important privacy and security distinctions compared to other personal cards like an airline boarding pass. On the other hand, older users are willing to sacrifice simplicity for better security. This is acceptable only to some extent though as the ease of use seems to be a very significant factor in their willingness to adopt such services. Based on the results obtained from the Mobile and Web Dashboard usability testing, most of the students find the interface of SEAL Dashboard moderately complex without any further instructions. Thus, the suggestions of the usability testers should be taken into account, especially those concerning the simplification of the whole process in order to improve the user experience of the SEAL service.

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8. References

- [1] SEAL D3.1 Technical documentation on common code of Platform, Ross Little, 2020.
- [2] SEAL D3.2 Technical documentation on modular interfaces for different types of identities, Ross Little, 2020.
- [3] SEAL D3.3 Technical documentation on web and mobile user interfaces, Victoriano Giralt, 2020.
- [4] SEAL D4.2 Operational and Technical Documentation of SP/AP integration (production), Petros Kavassalis, 2021

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9. Annex



SEAL Activity 5 testing.xlsx

(excel, included in the SEAL Testing annex files zip file)



SEAL Usability Report.xlsx

(excel, included in the SEAL Testing annex files zip file)



User survey on using SEAL issued UAegean myIDs Card (Responses).xlsx

(excel, included in the SEAL Testing annex files zip file)

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User survey on the use of SEAL Digital Verifiable Credentials in a real academic life setting

Please answer to the following questions:

* Required

About You

1. Greece *

2. Age *

Mark only one oval.

18-21

22-25

26-30

> 30

3. Gender *

Mark only one oval.

Male

Female

Prefer not to say

Other: _____

Questions about the UAegean myID Digital Credentials

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(pdf, included in the SEAL Testing annex files zip file)

SEAL Production Issuance Testing

SEAL Production Testing Scenarios	1
Issuance Test Scenarios	1
Test Case 1.1a - User accesses the SEAL Service in order to issue a myLinkedID VC	1
Test Case 1.1b - User accesses the SEAL Service in order to store a myLinkedID identity in a PDS	2
Test Case 2.1 - User accesses the SEAL Service in order to retrieve their eIDAS eID attributed and then issue a myeIDAS-ID VC	3
Test Case 2.2 - User accesses the SEAL Service in order to issue a myeduGAIN-ID VC	4
Test Case 3.1 - User accesses the SEAL Service in order to import their eIDAS eID attributes and then store them in a PDS	5
Test Case 3.2 - User accesses the SEAL Service in order to issue a myeduGAIN-ID PDS	6

Issuance Test Scenarios

Test Case 1 - User accesses the SEAL Service in order to issue a myLinkedID VC

Short Description of Test Case: The user wants to issue their electronic verified credential (VC) containing their Linked eIDAS and eduGAIN Credential, called myLinkedID. This VC combines the user's eIDAS attributes (i.e. attributes received through the user's country of origin) and their eduGAIN attributes (i.e. attributes received through the user's Academic Institution). The myLinkedID VC contains this information and stores it safely in an eWallet (in our case the uPort app) in the user's mobile phone.

Through this test case scenario, you will issue a myLinkedID VC and store it on your electronic wallet in your mobile phone.

Starting screenshot:

(docx, included in the SEAL Testing annex files zip file)

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SEAL Production Services Access Testing

SEAL Production Testing Scenarios	1
Service Access Test Scenarios	1
Test Case 1.1 - UPorto EWP Portal User wants to access the uPorto EWP Service using their SEAL issued myLinked-ID PDS	1
Test Case 1.2 - UJI Identity Module of the Student ERP User wants to access the UJI Personal Data Management Service using their SEAL issued Linked myIDs PDS	2
Test Case 1.3 - UAegean ERASMUS myIDs Card User wants to issue a VC and, later on, use it to prove their ERASMUS status	3
Test Case 1.4 - UAegean-HP Smart Class Program User wants to access the UAegean-HP Smart Class Service using their SEAL issued myLinkedID	4
Test Case 1.5 - UAegean Online course on cyber security User wants to attend the UAegean Online course on cyber security using their SEAL issued myLinked-ID	5
Test Case 1.6 - UAegean Central Authentication Service User wants to access the UAegean Central Authentication Service using their SEAL issued Linked myIDs VC	6
Test Case 1.7 - UMA Centralised Identity Authentication Service User wants to access the UMA Centralised Identity Authentication Service using their SEAL issued myLinked-ID VC	6
Test Case 1.8 - UMA Identity self-provisioning service User wants to access the UMA Identity self provisioning service using their SEAL issued myeduGAIN-ID PDS	7

Service Access Test Scenarios

Test Case 1.1 - UPorto EWP Portal | User wants to access the UPorto EWP Service using their SEAL issued myLinked-ID PDS

Short Description of Test Case: The user wants to sign in to the UPorto EWP Service using their linked PDS. The user's linked eIDAS and eduGAIN attributes are imported to the Service. The user then uses the service to find their Mobility status in the University of Porto.

Through this test case scenario, you will use your previously issued Linked PDS to find out your ERASMUS status at the University of Porto.

Starting screenshot:

(docx, included in the SEAL Testing annex files zip file)

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