DIGIWATER

Co-funded by the
Erasmus+ Programme
of the European Union

R2.2.6 REPORT ON PLATFORM OPTIMISATION

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the
Erasmus+ Programme
of the European Union

PROJECT INFO

Project title	Digitalisation of water industry by innovative graduate water education
Project acronym	DIGIWATER
Project reference number	621764-EPP-1-2020-1-NO-EPPKA2-KA
Action type	Knowledge Alliances in Higher Education
Web address	http://waterharmony.net/projects/digiwater/
Coordination institution	Norwegian University of Life Sciences (NMBU)
Project duration	01 January 2021 – 30 April 2024

DOCUMENT CONTROL SHEET

Work package	WP2 Digital Water Curriculum
Ref. no and title of task	T2.2.6 Platform Optimisation
Title of deliverable	R2.2.6 Digital Water e-learning platform v2
Lead institution	UCY
Author(s)	Dr. Thomas Photiades, Dr. Alexandros Yeratziotis, Marios Kyprianou
Document status	Final
Document type	Report
Document version and date	Final, 30-04-2024
Dissemination level	Public

Contents

1. INTRODUCTION

This report was generated in Task T2.2.6 – Digital Water e-learning platform v2 and is based on T2.2.5 – Platform Development. The T2.2.5 task is the development of the e-learning platform. In addition, within this task any required interactive tools related to the courses on IoT & Big Data in the water industry and physics & cyber security were designed and developed.

The T2.2.6 task consisted of platform adaptation to optimize functionality and usability based on feedback collected from the partners and testing conducted with potential learners.

2. E-LEARNING PLATFORM

2.1 Introduction

In this Section, an overview of the Digiwater e-learning platform is presented. The link to access the e-learning platform is http://digiwater.cs.ucy.ac.cy/moodle/

2.2 Front Page

The front page of the e-learning platform is shown in Figures 1 and 2 below.

Figure 1: Front Page of e-learning platform (first half of page)

Figure 1 depicts half of the front page of the platform. This page consists of the following:

- **Log in button:** On the top right of the page, there is a Log in button, where the user can login or create their account to have access to the platform.
- **Digiwater Logo:** Under the "Digiwater Platform" text is the Digiwater Project Logo, towards the left-hand side of the page.
- **Erasmus Plus Logo:** Under the "Digiwater Platform" text is the Erasmus+ Logo, towards the right-hand side of the page .
- **Flags of Partners' countries:** Below the logos are the country flags of the partners particpating in the project.
- **Partner Logos:** Under the country flags are the logos of all partners.

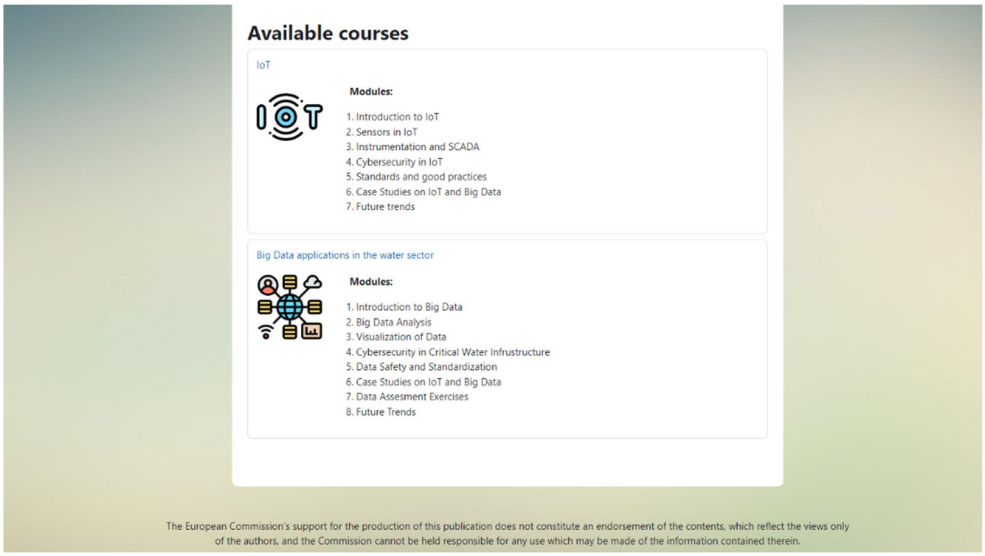

Figure 2: Front Page of the e-learning platform (second half of page)

Figure 2 presents the other half of the front page of the platform, which consists of:

- **Available Courses:** There are 2 courses available on the platform:
  - IoT
  - Big Data applications in the water sector
- **The seven modules of the IoT course:**
  - Introduction to IoT
  - Sensors in IoT
  - Instrumentation of SCADA
  - Cybersecurity in IoT
  - Standards and good practices
  - Case Studies on IoT and Big Data
  - Future trends
- **The eight modules of Big Data Applications in the Water Sector course:**
  - Introduction to Big Data
  - Big Data Analysis
  - Visualization of Data

- Cybersecurity in Critical Water Infrastructure
- Data Safety and Standardization
- Case Studies on IoT and Big Data
- Data Assessment Exercises
- Future Trends

2.3 Login Page / Create Account

When the user clicks on the “Log in” button, they will view the page in Figure 3.

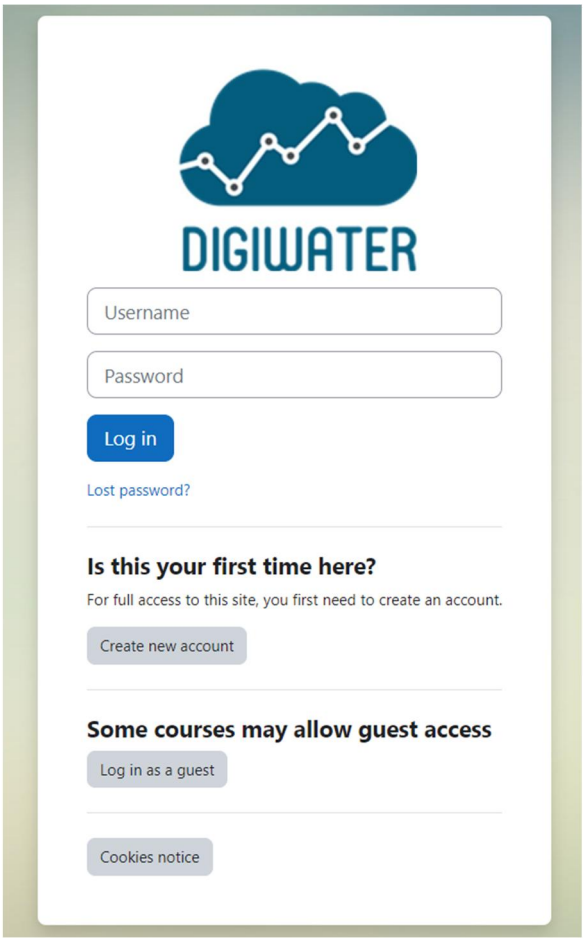

Figure 3: Login Page

If the user already has an account, the username and password will need to be inserted in the respective fields. Otherwise, the “Create new account” button must be clicked. Once clicked,

the user will be directed to create a new account and will need to complete the fields in Figure 4.

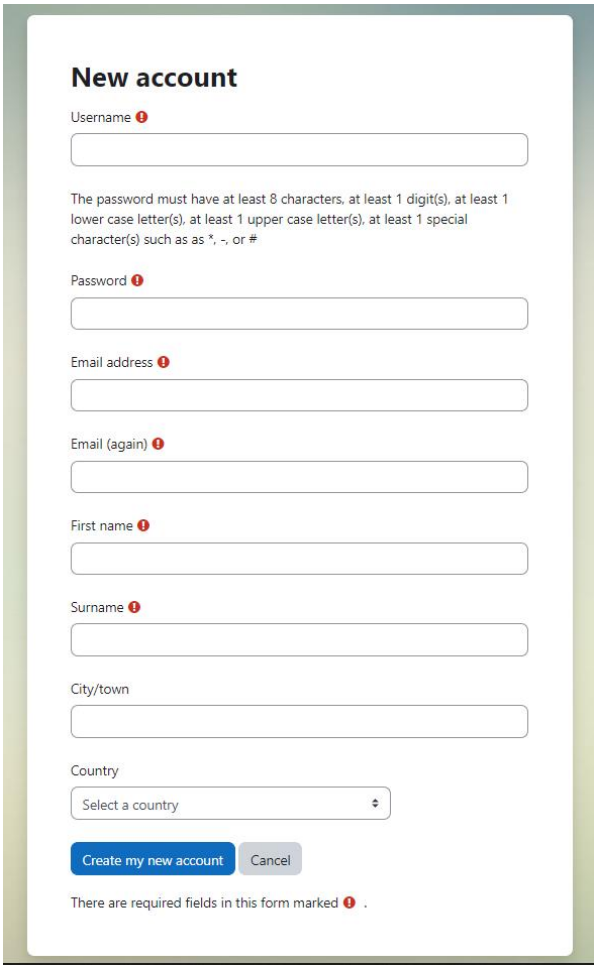

Figure 4: Create new account page.

The user will need to complete the fields to create an account. Fields with a red exclamation mark denote a required field. After completing the fields, the user must click on the "Create my new account" button.

2.4 Course Overview

When the user clicks on a course, its modules with respective descriptions are shown, as in Figure 5.

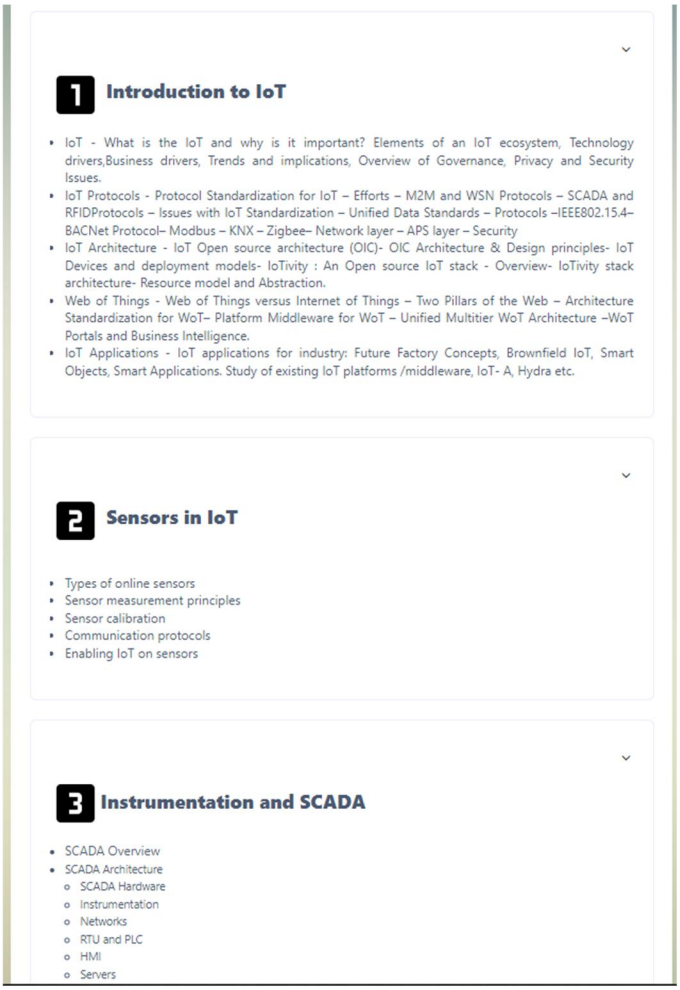

Figure 5: Course Overview

2.5 Module Overview

When the user clicks on a course module, its structure is shown, as in Figure 6.

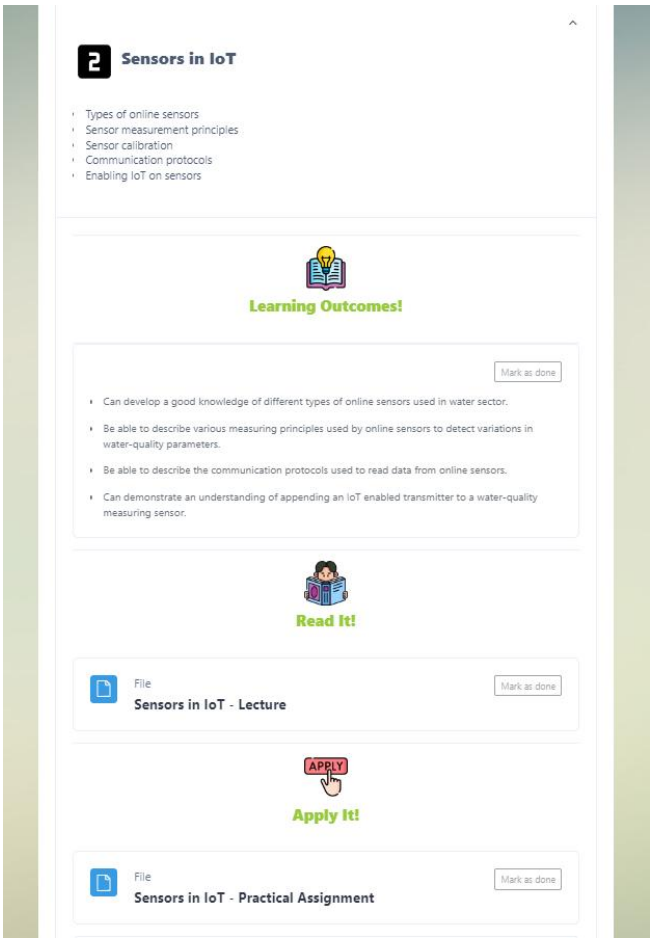

Figure 6: Module Structure

Each Module consists of:

- **"Learning Outcomes!" section**
  - Text with the Learning Outcomes of the module
- **"Read it!" section**
  - Lectures reading material in PDF format
- **"Apply it!" section**
  - Practical Assignment
  - Practical Assignment submission tool

3. LESSONS LEARNED FROM THE E-LEARING PLATFORM

We were able to learn from our participants who had used the e-learning platform. The most important points based on feedback collected are summarized below. In summary, the user feedback emphasizes the significance of user-centric design and flexibility. These lessons provide valuable guidance for future iterations and enhancements, ensuring that the e-learning platform remains user-friendly, adaptable, and aligned with user expectations.

1. **Learners and Teachers User Experience**: Both target groups exhibited positive preferences and opinions regarding the e-learning platform's usability. Any differences towards this were acknowledged, accommodated, and deemed crucial for enhancing overall user satisfaction.
2. **Flexibility in Features**: The feedback underscores the importance of flexibility in the e-learning platform's features. Users appreciate easy tasks like account activation but may have varying perceptions on more complex functionalities. Offering customizable features could enhance in this aspect.
3. **User-Centric Improvements**: Future developments should prioritize user-requested features, such as the integration of other tools. This user-driven approach ensures that the e-learning platform aligns with practical needs and expectations of both teachers and learners.
4. **Communication and Trust**: Building trust in the e-learning platform is important. Word of mouth, alongside social media and traditional advertising can contribute significantly. Open communication about any future improvements on the e-learning platform and addressing user concerns fosters a positive relationship between users and the e-learning platform.
5. **Adaptability to User Behavior**: Recognizing and adapting to various usage patterns, from daily to less frequent use, could be beneficial. Designing the e-learning platform to accommodate different levels of engagement ensures it remains relevant to a broad user base and provides personalized learning experiences.
6. **Continuous User Engagement**: The feedback emphasizes the importance of ongoing user engagement. Regularly seeking user input; teacher and learner, addressing concerns promptly, and implementing user-suggested improvements contribute to a dynamic and responsive e-learning platform. We know that we are only at the beginning of a long journey. The e-learning platform that has been developed so far is a good starting point for future developments and brings added value.
7. **Clear Communication of e-Learning Platform Benefits**: Educating users about the potential benefits of using the e-learning platform is essential. Clear communication

helps manage user expectations and fosters a positive perception of the value the e-learning platform offers.

Next, the learning objectives for each course module are presented, starting with those of the IoT course, followed by those of the Big Data applications in the water sector course.

3.1 IoT

3.1.1 Introduction to IoT

- IoT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.
- IoT Protocols - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols –IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security
- IoT Architecture - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.
- Web of Things - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture –WoT Portals and Business Intelligence.
- IoT Applications - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

3.1.2 Sensors in IoT

- Can develop a good knowledge of different types of online sensors used in water sector.
- Be able to describe various measuring principles used by online sensors to detect variations in water-quality parameters.

- Be able to describe the communication protocols used to read data from online sensors.
- Can demonstrate an understanding of appending an IoT enabled transmitter to a water-quality measuring sensor.

3.1.3 Instrumentation and SCADA

- What is a SCADA system,
- Where these systems are used,
- Component of SCADA systems,
- How to choose system components,
- How to program these systems,
- Industrial communication networks within SCADA systems,
- Security threats for SCADA systems
- Ways to protect against these threats.

3.1.4 Cyber Security in IoT

- Increase students' knowledge and readiness to defend themselves against cyber threats:
- understanding the world of cybersecurity and its importance
- understanding the most common cyber threats, attacks, and vulnerabilities and how they
- affect our data, network infrastructure, systems, and services
- understanding security countermeasures to protect data, networks, systems, and services
- using authentication, access control, encryption, backup, etc.
- understanding cybersecurity policies, procedures, and best practices for incident
- response, disaster recovery and risk management

3.1.5 Standards & good practices (incl. Legal Framework)

- Develop in-depth working knowledge of existing policies, standards, and guidelines
- Outline and describe good practices related to the use of IoT
- Examine guidelines and standards related to cybersecurity for IoT products
- Develop a good knowledge of how the European Union (EU) regulates IoT cybersecurity and privacy
- Participate in policy debates about emerging IoT standardization issues and their regulation at domestic, European, and international levels

3.1.6 Case Studies on IoT and Big Data

- Insight in practical applications involving digitalization in the water sector.

3.1.7 Future Trends

- Explain current IoT applications, trends, and implications
- Understand where the IoT concept fits within the water sector and possible future trends
- Discuss IoT application usage in digital water and smart cities
- Describe IoT connectivity and networks
- Apply real-time and local analytics
- Appreciate the role of big data, cloud computing, and data analytics in a typical IoT system

3.2 Big data applications in the water sector

3.2.1 Introduction to Big Data

- Understanding relevance and importance of Big Data for water applications

- Acquire general knowledge and experience in the domain of Big Data
- Grasping basic terminology and awareness
- First hands-on experience with real-life dataset

3.2.2 Big Data Analysis

- Acquire understanding of the sophisticated concepts and features of big data, ML and AI technologies and applications
- Acquire understanding of big data models, AI models, and their technical features, as well as build deep insights about what kinds of applications they can support
- Analyze the impact of advanced big data techniques for real-world business decisions and strategy applied in international companies.
- Acquire a complete and in-depth landscape of the history, development and various applications of AI in various real-world business sectors
- Master AI techniques, including knowledge representation and reasoning process techniques, and be able to apply them in business applications
- Develop skills in ML, such as linear regression, decision tree induction, and artificial neural networks, and be able to devise new real-world solutions by applying the skills.

3.2.3 Visualization of data

- Develop a good understanding of different types of data sets and way of visualizing them.
- Understanding the optimal dashboard layout for data representation.
- Analyze different visualization tools available in the market and identify the level of expertise required to use them.
- Understand the pros and cons of using a web-based visualization tool versus and app-based visualization tool.

- Demonstrate an ability to use tools to build basic dashboard layouts to visualize various datasets.

3.2.4 Cybersecurity in Critical Water Infrastructure

- Develop a good knowledge of critical water infrastructure and its dependency
- Describe typical threats to modern water systems and outline techniques of defense against the threats
- Analyze critical water infrastructure and industrial control system security vulnerabilities and develop defensive measures
- Explain international cybersecurity standards and illustrate the context in which these are used to defend against cybersecurity threats
- Demonstrate an understanding of the specific regulatory and cybersecurity compliance requirements in the critical water infrastructure

3.2.5 Data safety and standardization

- Can recall different database technologies and communication protocols
- Can discuss different types of data, which threats they face and the damage these threats can cause
- Know that there are different regulations that need to be followed for different types of data in different parts of the world
- Describe steps to take for securing data and restoring data in case of data breaches
- Be able to understand the function and purpose of encryption
- Be able to discuss the need for standardized data structures
- Be able to plan a data structure to store data and examine already existing data structures

3.2.6 Case Studies on IoT and Big Data

- Insight in practical applications involving digitalization in the water sector

3.2.7 Data assessment exercises

- Students identify access to public data
- Students are able to implement simple data analysis tools
- Students are able to assess data quality and interaction between data

3.2.8 Future Trends

- Describe applications of big data in the water sector
- Know about current research and industry trends of big data applications in the water sector
- Describe how big data analytics can solve problems in the water sector and other disciplines
- Optimize processes and create more accurate forecasting and predictive models
- Develop a good knowledge of the security and privacy of big data

4. Optimization/Feedback

4.1 Introduction

In this section, the process of using the feedback for the optimization of the platform is discussed.

4.2 Procedure

After the development of the platform, a consortium meeting was organized where UCY informed partners that the platform is ready to be explored and for participants to provide their feedback.

The main steps in the process were:

1. Participants were provided with a 2-week deadline to explore and review the platform.
2. Instructions were sent to participants on how to create their own account to access the platform.
3. Participants provided their feedback within the deadline.
4. UCY proceeded to implement improvements or suggestions deemed necessary.

4.3 Feedback

In accordance with Section 3, lessons learnt highlighted important aspects to consider for the sustainability of the e-learning platform. Looking at the feedback specifically, most of it was positive, i.e. “looks very good”, “was user-friendly”, “easy to use”. Minor comments addressed included:

- Correcting typos in texts.
- Adding country flags and logos of the consortium partners on the home page.
- Adding the correct EU disclaimer on the e-learning platform.
- Displaying the modules of each course on the home page, without needing user registration.