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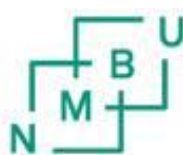
“Working together for a **green**,
competitive and **inclusive** Europe”

Project: *Digitalisation of water sector and water education* - **DIGIWATRO**,
Contract: 20-COP-0050

Intellectual Output 3: *Boosting the digital skills of teachers and learners to promote digital innovations in the water sector with hybrid learning*

Disclaimer

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Norwegian University
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1. Introduction

The water sector often lags in adopting new ideas as it tends to stick to old ways of thinking and lacks innovative teaching methods with entrepreneurship and new concepts. Another related issue is finding funding resources to support new ideas in many countries. On the other hand, water higher education institutions (HEIs) often struggle to keep up with the latest digital tools and teaching approaches. This means many teachers have to use these tools without proper training. Therefore, there is an urgency to prepare future experts who can use digital tools and create new ideas. To do that, we should change what HEIs teach to focus on important new topics, like the integrated water system urban areas, IOT services for water, and protection of water infrastructure against cyber threats, etc.

Innovations in the water domain are fragmented. A joint effort from companies, academia, and government (triple helix) is required to facilitate the uptake of digital innovations in operational environments. A strengthening of the education to prepare the future employees for the digitalising world is needed. Stakeholders are today not adequately active/cooperative, when seeking innovative digital solutions. A closer interaction within the triple helix can improve this.

The rapidly increasing and vast amounts of data in various water sectors give rise to a plethora of opportunities, not only to increase a system's quality, but also to provide more integrated, cost-efficient and secure services to the end-users and population. The rising demand and competition for water puts a strain on resources and poses a growing risk to the economy, communities and ecosystems. At the same time, rapid urbanization, climate change and population growth further increase the risk of both droughts and floods. Therefore, it is vital to find solutions to protect and manage this most precious, yet scarce resource. However, many water managers act without adequately reliable or objective information, rely on incomplete data, and lack key technologies. Although promising conceptual and technological solutions to water systems security and resilience are available, further work is required to bring them together in an overarching management framework that strengthens the capacities of water utilities to efficiently manage the infrastructure.

The COVID-19 pandemic as a recent crisis has illustrated starkly the need for preparation, improved capacity and resources. As a consequence of the scenario of COVID-19, recovery and building resilience has been prioritized as a way to move forward for effective strategic crisis management. Among these efforts is boosting digital transformation and building digital readiness. Promoting the digital sphere could cover specific needs and issues of particular importance that emerge for the resilience of critical infrastructures in both Norway and Romania.

UNESCO estimates that over 1.5 billion students in 165 countries are out of school due to the COVID-19 pandemic. The pandemic has forced the global academic community to explore new ways of teaching and learning, including distance and online education. This has proven challenging for both students and educators, who must deal with the emotional, physical, and economic difficulties posed by the illness while doing their part to help curb the spread of the virus. The future is uncertain for everyone, particularly for millions of students scheduled to graduate this year who will face a world crippled economically by the pandemic. Realizing these facts, this Intellectual Output aims to significantly raise the capabilities of the teaching

staff of the involved universities and develop and institutionalized concepts for solid and consistent use of digital tools.

Hybrid learning is an educational approach that combines both traditional, in-person classroom instruction and online learning. In a blended education model, students engage in a mix of face-to-face teaching with their instructors and self-paced online activities or content. This approach seeks to leverage the benefits of both in-person and online learning to create a more flexible and effective learning experience. Therefore, hybrid education offers exciting possibilities, but it's essential to recognize that many Higher Education Institutions (HEIs) are just beginning to explore its potential. The transition to hybrid learning, especially in the context of water-related disciplines, presents a significant opportunity to harness digital tools effectively. Adopting such an approach offers several advantages, including increased flexibility for students to access learning materials and engage with course content at their own pace, as well as the opportunity for more interactive and personalized instruction during in-person sessions. Additionally, it ensures that up-to-date knowledge and innovative teaching approaches are accessible to a broader audience, transcending geographical constraints. It paves the way for a more inclusive and responsive educational landscape, addressing the unique challenges of the water sector while equipping students with the digital skills necessary to thrive in this dynamic field.

In DIGIWATRO, we work towards enhancing the capabilities and competences of teaching staff and fostering consistent digital tool usage, we are not only advancing education but also bridging the gap between the classroom and the evolving requirements of the water sector in Romania. The synergy between traditional education and digital tools will serve as the cornerstone for a more agile, adaptable, and digitally empowered approach to learning and innovation in the water sector in Romania.

To achieve this IO's objective of "significantly raise the capabilities of the teaching staff of the involved universities and develop and institutionalized concepts for solid and consistent use of digital tools", this IO will encompass the following key components:

1. **Digital and Remote Teaching Approaches:** This section will delve into the effective utilization of digital and remote teaching methods, exploring the advantages and practical implementation of these innovative approaches.
2. **Cutting-Edge Hybrid Learning Concepts:** The IO will also spotlight the latest developments in hybrid learning concepts. It will shed light on the innovative techniques and strategies that empower educators and enhance the learning experience for students.
3. **Valuable Lessons and Best Practices:** Another crucial facet of the IO will be the sharing of valuable lessons learned and best practices. It will draw upon real-world experiences to distill practical insights that can guide educators and institutions in navigating the evolving landscape of education.

2. Methodology

2.1. The concept behind the methodology

Joint efforts between NMBU and UGAL were undertaken to produce this IO3. NMBU's efforts focused on summarizing the broader efforts undertaken to advance digital and remote teaching approaches in the water sector and share the knowledge with UGAL. As for UGAL, their role focused on coordinating and implementing education related to process surveillance and control with a specific emphasis on European perspectives in engineering and chemical technologies. Figure (1) summarizes the work and the different tasks behind creating this IO.

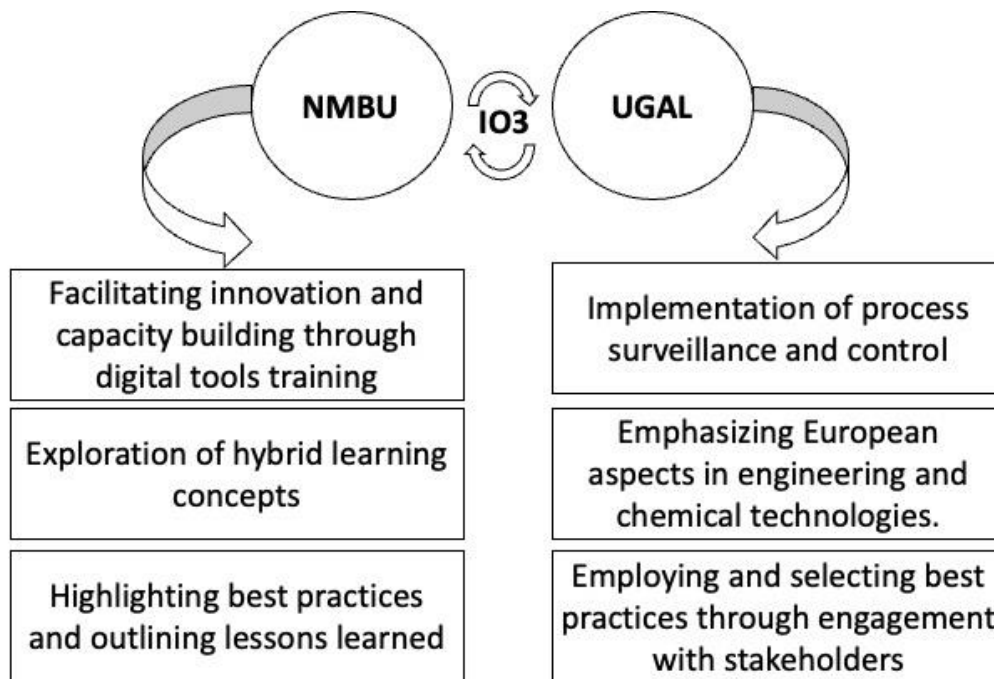


Figure 1 The work description of IO3.

2.2. How to read this report

In order to produce and discuss each component of this report, we followed a specific approach that can be replicable and transferable for any sector. Here are the steps we followed:

- The required practices: Identifying the topic of the component as well as the objectives we are aiming for in order to brainstorm the required practices to move forward.
- The digital tool for brainstorming: It was selected according to the outcome based on the needs, challenges, and points of discussion.
- The input was produced based on the literature review as well as the attendees' participation.
- Debriefing: This step outlines the lessons learned and highlighted the best practices.

3. Facilitating innovation and capacity building through digital tools training

3.1. Dissemination of research results to the water community in Europe and beyond

However, whilst the research community is carrying out intensive and comprehensive research and development on the challenges related to human health and environment, the water sector has been slow to take up innovations. The European Innovation Partnership on Water (EIP Water) identified several barriers and bottlenecks for innovation in the water sector including lack of funds for SMEs; general risk aversion; a lack of demonstration sites; inconsistency and fragmentation in policies and regulations; fragmentation in water authorities and water sector; and conservative procurement.

A workshop was carried out to list the bottlenecks in innovation uptake and successful tools, incentives, processes, and practices in water higher education in Europe and beyond. The attendees joined from different locations across Europe while others joined from Eastern Asia. [GroupMap](#) was used a digital tool for brainstorming individually on the bottlenecks they face in innovation uptake as well as the successful tools, practices and process to overcome the challenges of dissemination knowledge. Participants individually listed their ideas, which were then collaboratively grouped into common themes. Afterwards, the facilitator with the support of attendees grouped the ideas and asked the attendees to vote to prioritize the practices needed. Each participant was then given five votes, with multiple votes allowed per idea. Figure (2) shows the process followed in conducting the results for this workshop.

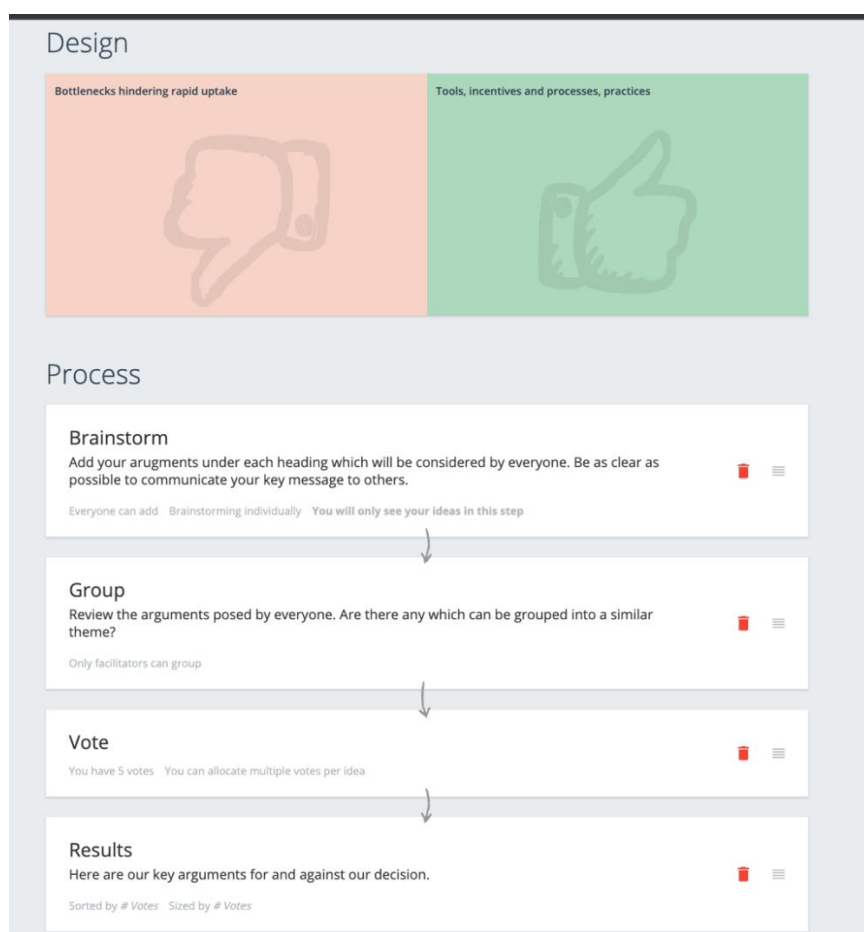


Figure 2 The process in GroupMap for dissemination research results.

Figure (3) summarizes the final results of this workshop.

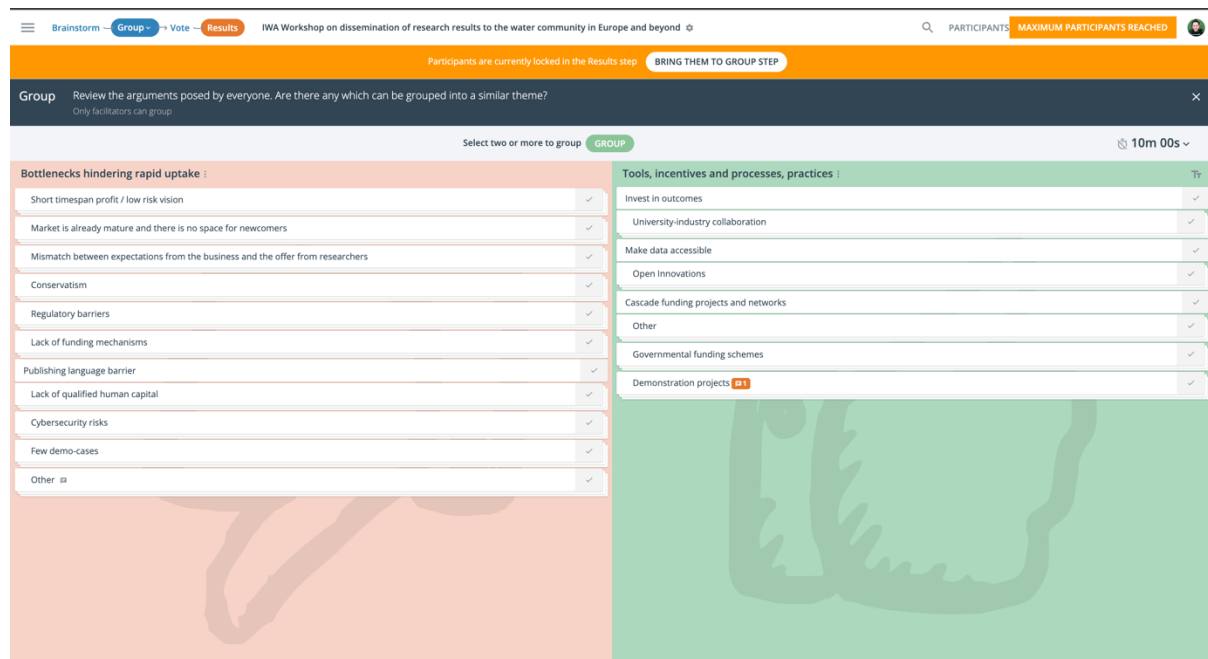


Figure 3 Summary of the workshop outcome.

The attendees pointed out the following as top bottlenecks hindering innovation uptake:

Policy and regulatory barriers within the sector: Policies and regulations are, at times, cumbersome, inconsistent and fragmented. There is a lot of red tape leading to long approval times for new projects. Examples include strict regulations due to health risks, data/cyber security risks, and competition laws which hinder sharing of best practice between companies.

Poor business investment case: Much water infrastructure is long lasting (100+ years) and has high investment costs. This makes it difficult to build the business case, with companies operating on short term business cycles and seeking acceptable returns on investment. To make the business case positive often requires a large-scale roll-out. Changing long lasting existing infrastructure that is already in place is both unsustainable and expensive. In addition to this the low cost/value of water affects the business case.

Lack of funding mechanisms: Given the risks of new technologies and the high Technology Readiness Levels needed in the sector, there is little encouragement to take on these risks, with no structural risk funding available. Financial support is needed from the initial idea through to full scale operations.

Expectation mismatch: There is often a mismatch in expectations between the business' needs and the researchers' innovation offering. Many researchers lack industrial exposure and are unfamiliar with the challenges of water services. There is a lack of understanding across the sector, including researchers, buyers and regulators, on how to encourage innovation development and uptake

Industry conservatism: The water industry is generally conservative and risk averse with a business-as-usual approach, focused on operations. Key Performance Indicators are linked to operations not innovation. In this context innovation is seen as a threat or a risk. Procurement is normally conventional and linear and tends to pre-describe solutions rather than seek new ways of doing things.

Lack of human capital – resources, knowledge and skills: End users lack time to explore innovations and often don't know about them. They are focused on daily operations. Businesses have low scientific knowledge and researchers have low business and management skills.

Other issues identified also included:

- A lack of demonstration projects and sites
- Publishing language barriers.

Regarding the best practices, the attendees listed the following as best practices and tools needed to promote innovation and knowledge sharing the water higher education:

Improve industry-university collaboration: The key message was that solutions must be co-designed with end users, with all stakeholders engaged throughout the R&D process, using a cross-disciplinary approach. Some ideas to encourage this collaboration included: developing joint organisations between universities and industry; research students being given industrial exposure to familiarize them with the challenges faced by industry e.g., through industrial internships; joint PhD projects between industry and universities.

Funding: Regional and national funding is needed to support innovation from the initial idea right through to full scale operations. Funding needs include for research in the digitalisation sector; project development and structural risk funding/investment.

Operational testing and demonstrations: Any solution must be resilient, robust and reliable with testimonials being very important. Demonstration sites such as at the water and wastewater utilities are critical.

Make data accessible: We have to consider ways to allow for sharing of information and improved data accessibility across the sector, maintaining GDPR and data safety.

Improved procurement processes: Procurement needs to move away from pre-defining the solution, focusing instead on identifying the specific challenge or problem to allow bidding for innovative solutions. The R&D for these solutions could then be supported if necessary. Innovation should be a key criteria and procurement policy needs to be based on circular economy principles and full product life cycle analysis. This includes requiring information about the carbon footprint of products, upstream suppliers, contractors and partners.

Human capital: Researchers need to receive more industrial exposure allowing them to better understand the challenges faced by users in the field. Operators/end users need to know about innovations and have opportunities to explore them. There should be more development opportunities for end users to increase their skills e.g. in programming and handling large data sets. Research project development should be undertaken jointly between universities and industry, drawing on the different and complementary knowledge and skillsets. The water sector needs to ensure that they employ people with the necessary skills and knowledge to deliver outcomes.

Move from value chains to value networks: This can be executed by including utilities, engaging all stakeholders, collaboratively creating the revenue model, and employing a cross-disciplinary approach to project development.

Increase the marginal cost of water: This will make business cases for innovative technologies more competitive, shortening the time to achieve a return on investment.

3.2. The Role of Triple Helix Collaboration in Digital Tools Training for Water Education and Industry Innovation

In the context of fostering innovation and building capacity within the water education and industry sectors, the Triple Helix model plays a pivotal role in promoting cross-sector collaborative efforts among academia (universities and research institutions), industry (businesses, SMEs, water utilities and corporations), and government (public sector and regulatory bodies). Figure (4) presents this model and how the different actors can interplay to promote innovation.

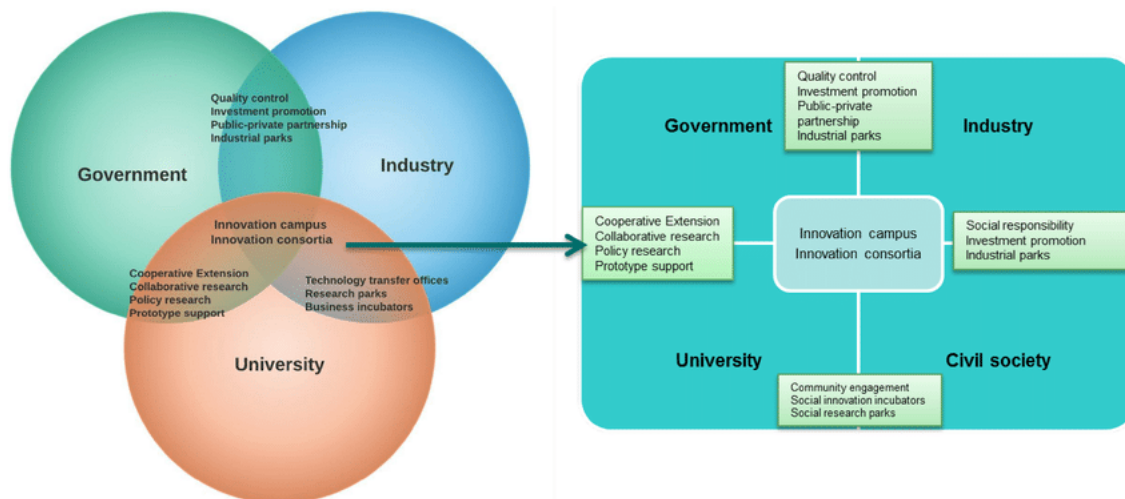


Figure 4 The Triple Helix model for promoting innovation.

A workshop was held among different actors across Europe where GroupMap was used a digital collaboration tool. Figure (5) summarizes the discussion that took place there.

The thematic categories for the outcome of the discussion can be organized as follows:

- Collaboration and Networking to create a dynamic ecosystem for knowledge exchange.
- Strengthening the industry-University Interaction by building industry linkages and ensuring regular consultations, the water sector can ensure a seamless flow of knowledge and expertise, promoting practical solutions for real-world challenges.
- Capacity Building and Training by balancing teaching and research in water higher education paves the way for holistic skill development. Capacity building through digital tools training and the provision of co-working spaces can empower the next generation of water professionals.
- Challenges and Constraints including addressing financial constraints and overcoming time and financing issues is essential for sustainable growth in the water sector. Also tackling the lack of capacity, time, and recognition of the need for collaboration requires a strategic approach that aligns the goals of academia, industry, and government.
- Promoting research and Innovation that aim to generate tangible solutions that benefit the water sector by specifying collaborative targets and initiating seed grant projects with industries can drive focused research and innovation efforts. Additionally, sharing responsibilities among stakeholders can lead to well-rounded projects.
- Global Collaboration: Embracing technology transfer from developed countries to developing countries through international contracts can accelerate progress in the water sector, creating a global network of shared knowledge and resources.

What experience you have with the triple helix model?	What challenges you expect?
companies are accepting student intership for recruitment <input type="radio"/>	Industries are very dynamic and expect quick solutions <input type="radio"/>
Industry Linkages <input type="radio"/>	sharing responsibilities <input type="radio"/>
University business linkage cell <input type="radio"/>	financial constraints of governments <input type="radio"/>
Consultancy work <input type="radio"/>	lack of chance to deeply communication <input type="radio"/>
academic institutions can work as moderation between different partners <input type="radio"/>	Balance between teaching and reseach <input type="radio"/>
consultancy service for finding technical solution for specific issues <input type="radio"/>	developing countries will depend on technology transfer from develop countries through international contracts <input type="radio"/>
Industry Consultative Committees <input type="radio"/>	Commitments from the industry partner for regular consultations <input type="radio"/>
majority of bachelor and master thesis are in cooperation with industrial partners <input type="radio"/>	less knowledge on industrial process (process management) <input type="radio"/>
academia and industry collaboration <input type="radio"/>	mutual trust <input type="radio"/>
Stakeholder engagement and interaction within association <input type="radio"/>	Many academics lack industrial exeprience <input type="radio"/>
Multi-lateral implementation in platform projects <input type="radio"/>	Data presentation and data log establishment <input type="radio"/>
Bilateral implementation <input type="radio"/>	time and financing issues <input type="radio"/>
	Lack of capacity / time <input type="radio"/>
	Commitment to real work <input type="radio"/>
	Promoting from the passenger seat to driver's seat <input type="radio"/>
	Lack of recognition of the need <input type="radio"/>
What can you do to initiate such collaboartion?	Concrete planes - how, when and participants?
specify the targets of following up in the process <input type="radio"/>	Common platform for data sharing <input type="radio"/>
Seed grant projects with industries <input type="radio"/>	assign a advisory board representing all parties <input type="radio"/>
Guideline on the way how it should work <input type="radio"/>	Capacity building <input type="radio"/>
co-working spaces <input type="radio"/>	flexible and resilient policy of university for the collaboration <input type="radio"/>
students as a creator of "crazy ideas" <input type="radio"/>	Start from some mini kickoff project and then keep it moving towards more comprehensive collaborations <input type="radio"/>
Start discussions targeting tri-party MoUs <input type="radio"/>	Convene water sector industry consultative committee and present their challenges, design student projects, include industry co-supervisors <input type="radio"/>
finding a circle of the willing <input type="radio"/>	contact decision makers and query the internal needs <input type="radio"/>
Regular industry-department meetings <input type="radio"/>	Industry Advisory Board at the faculty <input type="radio"/>
Session from the industry to present the industrial challenges <input type="radio"/>	Scanning of the funding landscape for suitable opportunities <input type="radio"/>
Improve visibility in professional networks, conferences etc. <input type="radio"/>	collaboration in line with government policy. <input type="radio"/>
identification of future topics on which thesis may work <input type="radio"/>	
Networking <input type="radio"/>	
Initiate projects with several stakeholders <input type="radio"/>	
purpose the idea for research <input type="radio"/>	

Figure 5 Summary of the workshop outcome on promoting innovation in the water sector.

4. Exploration of hybrid learning concepts

4.1. An overview of the learning management system (LMS) for harmonization of water-related education

The learning management system is a software application or platform designed to facilitate the management, delivery, and tracking of educational courses and training programs. LMSs are commonly used in educational institutions, businesses, and organizations to create, administer, and manage various learning activities, including online courses, training modules, and educational content. They typically offer features for course creation, content storage, student enrollment, tracking of student progress, assessment and grading, and communication tools to facilitate online learning and training. LMSs are valuable tools for delivering and organizing educational content, especially in the context of e-learning and remote learning.

The evolution of Learning Management Systems (LMS) has seen significant developments over the years which have been reflecting the changing needs and technology trends in education and corporate training. The ongoing development and adaptation of LMS platforms are essential to meet the diverse demands of modern learners and educators in an ever-changing digital landscape. Figure (6) presents an overview of some key stages in the evolution of LMS and can be summarized as follows:

1. **First-Generation LMS (Late 1990s - Early 2000s):** The early LMS platforms were primarily focused on managing and delivering e-learning content. They offered basic features for creating and delivering online courses. These systems were often limited in terms of interactivity and user experience.
2. **Second-Generation LMS (Mid-2000s):** The second-generation LMS introduced more advanced features, such as online collaboration tools, discussion forums, and the ability to track and report on student progress. These LMS platforms aimed to enhance the interactive and social aspects of online learning.
3. **Open Source and Cloud-Based LMS (Late 2000s - Early 2010s):** Open-source LMS solutions, like Moodle and Sakai, gained popularity, offering cost-effective alternatives for institutions and organizations. Around the same time, cloud-based LMS platforms started to emerge, making it easier for users to access and manage their e-learning systems from any location.
4. **Third-Generation LMS (2010s - Present):** The third generation of LMS platforms introduced a more user-friendly and intuitive interface, as well as mobile compatibility. They expanded to support a broader range of e-learning content types, including multimedia and gamification. Integration with other educational technology tools and the use of analytics to personalize learning experiences became standard features. Additionally, they addressed the shift toward blended and flipped classrooms.
5. **Personalization and Adaptive Learning (Recent Years):** Modern LMS platforms continue to evolve with an emphasis on personalization and adaptive learning. They use data-driven insights to customize learning paths for individual learners. These platforms aim to provide tailored content, assessments, and support, which is especially relevant in the context of online education and employee training.
6. **Integration and Ecosystems (Current Trends):** Today's LMS solutions are increasingly part of a broader educational technology ecosystem. They integrate with other tools such as video conferencing, learning analytics, content management systems, and more. This

integration enhances the overall educational experience and helps organizations streamline their learning processes.

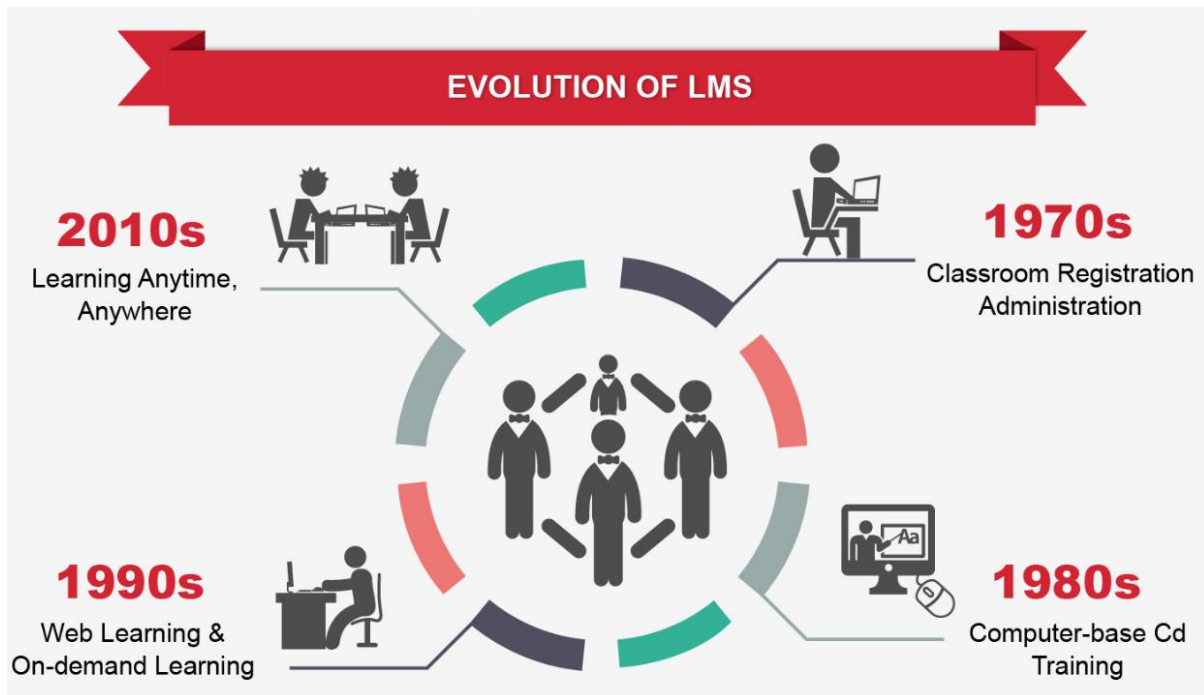


Figure 6 The evolution of LMS.

In the dynamic field of water higher education, the Learning Management Systems (LMS) can play a pivotal role in transforming the way we deliver and manage educational content. In the following, we explore how LMS aligns with the goals and demands of water higher education:

- **Enhancing Accessibility and Inclusivity:** Modern LMS platforms prioritize accessibility and inclusivity, ensuring that all students, including those pursuing water-related studies, have equal access to educational resources. This aligns perfectly with the goal of reaching a diverse audience within the water sector, regardless of their unique learning needs.
- **Adaptive Learning for Water Education:** Using LMS enables educators to tailoring learning pathways to students' specific interests and goals, whether they are focusing on water management, environmental science, or engineering.
- **Data-Driven Insights for Water Management:** Using LMS enables educators to tracking and analyzing student performance and engagement. Educators can gain valuable insights into teaching effectiveness and potentially identify students who may need additional support.
- **Community Support in Water Higher Education:** Online communities and user groups are instrumental for water higher education. They enable students and educators to collaborate, share insights, and work together on research projects, which are often fundamental in the water sector.

4.2. An overview of the EduWater platform

[EduWater](#) is Water Harmony Community Hub (Figure 7) which was designed to facilitate the sharing of eLearning resources and experiences within the field of water-related higher education. It aims to play a valuable role in fostering collaboration and knowledge exchange among institutions, educators, and students in water higher education. It serves as a repository for eLearning content, best practices, and innovative teaching methods, thereby enhancing the quality of education and research within the water sector in Europe and beyond.

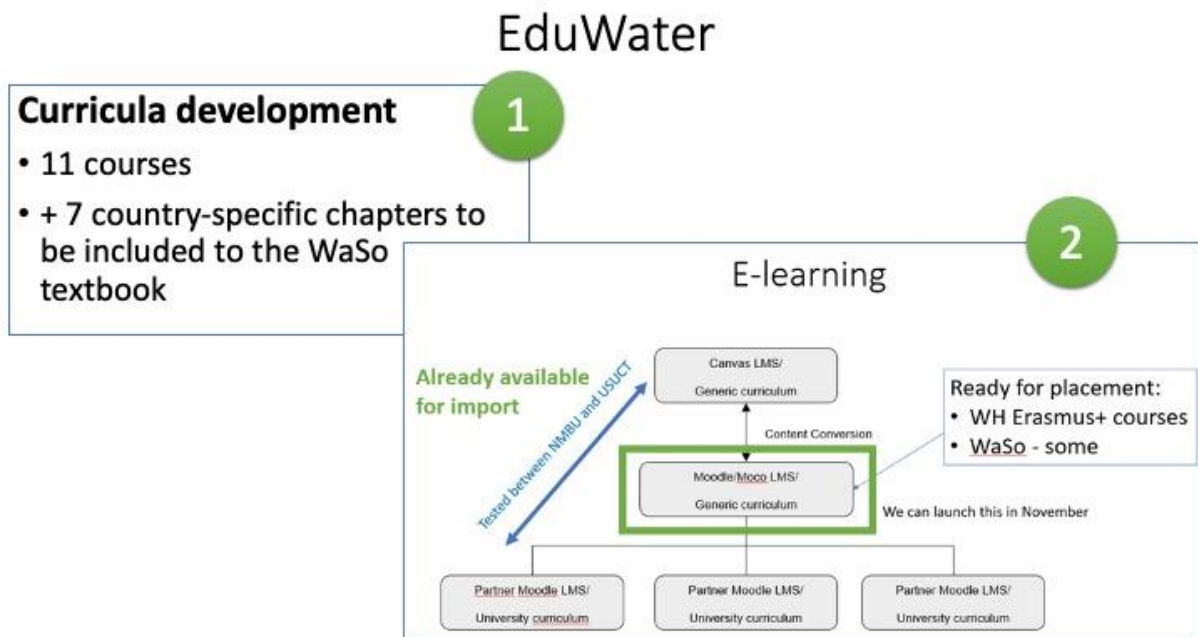


Figure 7 The development of EduWater platform.

[There are 11 courses uploaded on the platform](#) where visitors can log in as guests and download the courses. Figure (8) shows some of these courses. Each course has theoretical and practical sections with its introduction and learning outcomes.

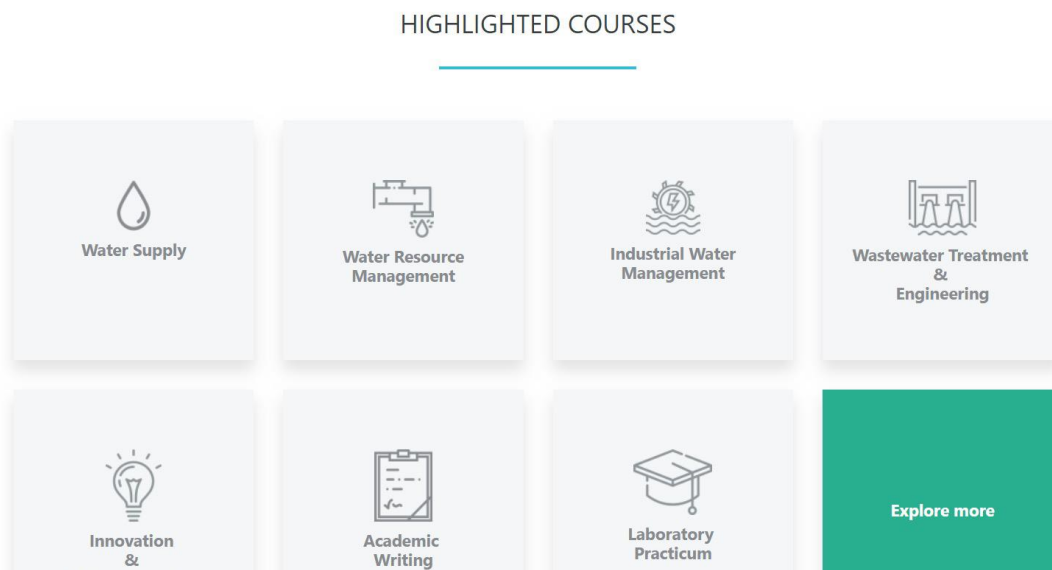


Figure 8 The available course in EduWater.

EduWater targets two main categories: Educators and students with options that suit their needs. Figure (9) shows the options that the educators have at EduWater while Figure (10) shows the options for students.

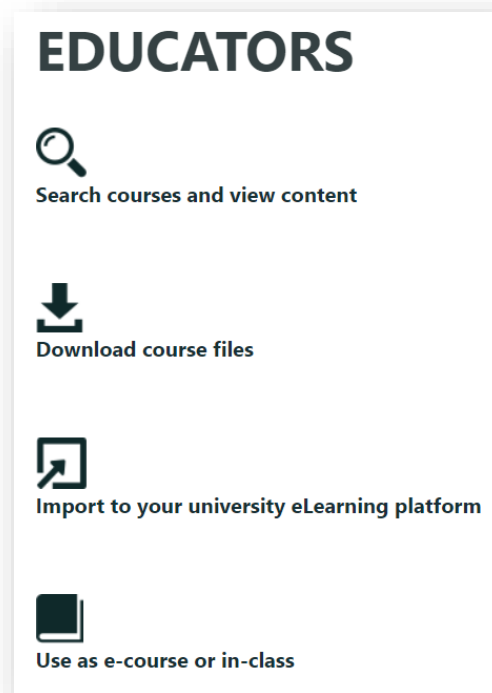


Figure 9 Educators' options at EduWater.

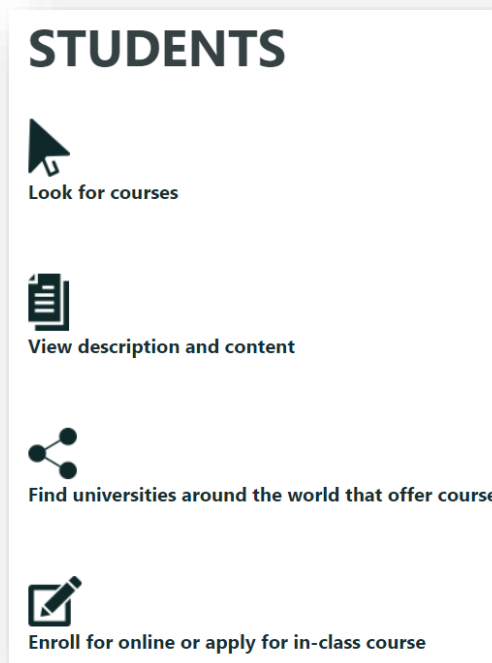


Figure 10 Students' options at EduWater.

4.3. Tools for digital interaction in water higher education

Digital collaboration tools leverage the digital space to improve workplace collaboration, communication, content management, and information flow in any training or workshop. A collaborative workshop is a meeting with the participants where they will work together toward a shared vision or goal.

The aim of using such tools is to improve the participants' productivity and efficiency and make the learning experience and sharing ideas easier. Many activities can take place in a digital canvas where there are limitless possibilities for brainstorming, decision making, etc. Many digital tools are available in the market. But first make sure you think through the following before choosing the digital tool:

- When will your workshop be hosted?
- Who are the targeted participants?
- Are the attendees going to join at the same time or according to their availability and time zones? This is a great way to identify the interaction: Is it a real-time one?
- How long will your workshop last?
- Who will facilitate?
- What's the goal of your workshop?
- What are the outcomes of your workshop?
- Is there a need for a follow-up from attendees? If yes, in what form?

4.3.1. Digital collaboration tools

Miro (<https://miro.com/>) is an online collaborative whiteboard to support the collaboration within the team. It helps in bringing together all participants to work together to brainstorm ideas, make decisions, give feedback, and boost productivity. It can be used for facilitating meetings, workshops, team building and research. This platform provides a real-time interaction.

Pros of using Miro:

- Miro is easy to use and navigate not only by the designer but also by the participants.
- It has features that provide an inclusive experience (video chatting, voting, chatting, presentation mode, timer).
- It has a huge rich library of templates which can be used in different activities if the trainer doesn't want to customize its workshop.
- Miro is free for students and universities.
- Preparing the setup of the workshop is easy and can be presented beforehand, so participants can expect the flow and maybe prepare.
- It supports creating the nurturing environment for serious games.
- Universities can obtain free subscriptions

Challenges of using Miro:

- It is more of a real-time platform. This means it isn't always easy to go back to Miro and check what has been done in the workshop if the person didn't attend.

- Some people may get lost in this unlimited whiteboard, so the trainer always needs to pay attention that all participants are in the same workplace.
- The free version gives limited access to white boards and upgrading to other plans asks for prices that many universities can't afford.

Some useful links to know more about Miro:

- [Miro Academy](#)
- [Miro channel on YouTube](#)
- [How to get started with Miro](#)
- [Miro products and Demo](#)
- [Tips and tutorials from Miro users](#)

An example of using Miro in IoTs in water utilities is given in Figure (11).

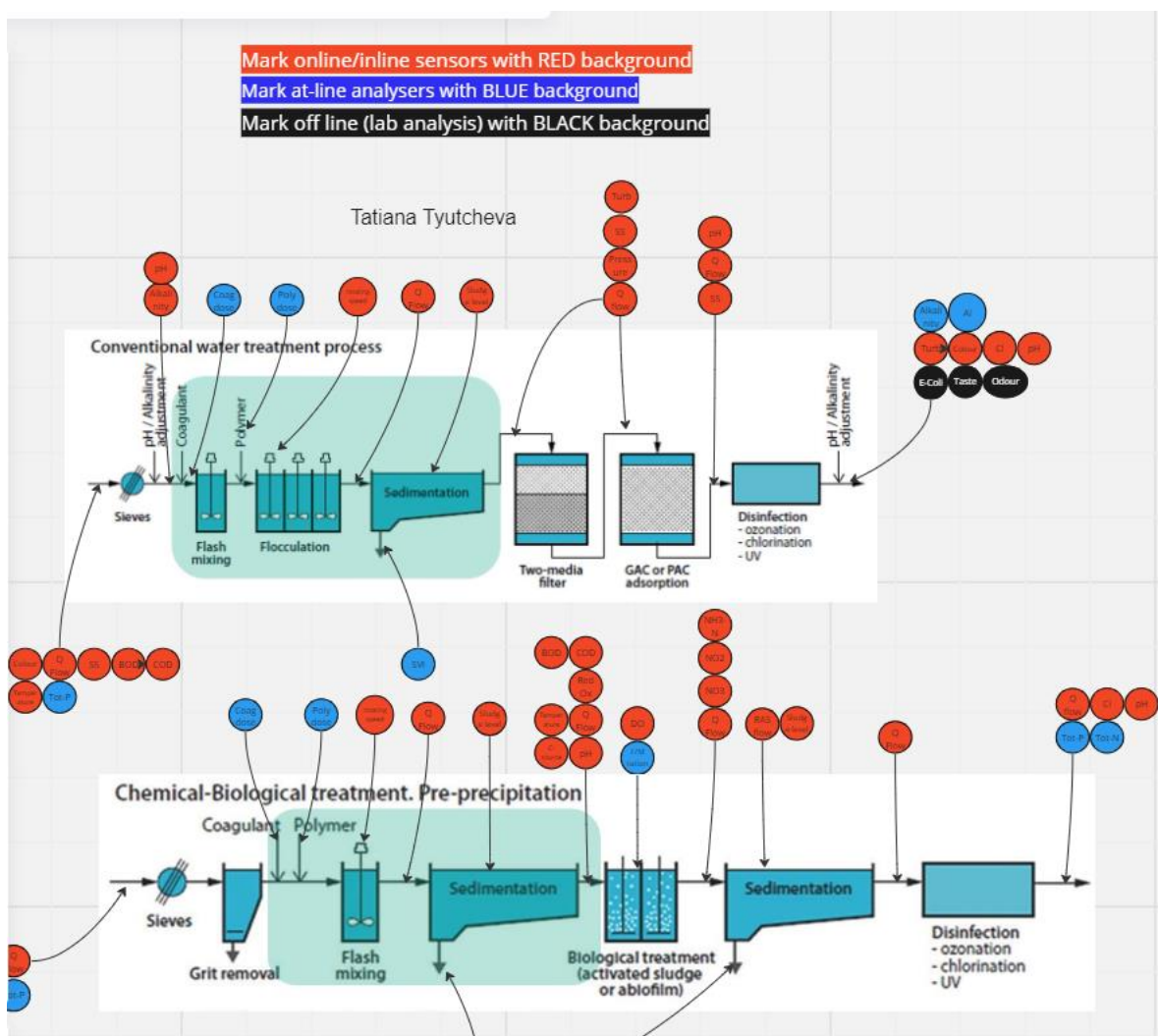


Figure 11. Student task to place IoTs in flowsheets

GroupMap (<https://www.groupmap.com/>) is a virtual open space that captures individual thinking first, then reveals the group perspective, all in real-time. It can support the processes of planning, discussion and decision-making in any activity or event. In short, it is

an online brainstorming and group decision-making tool that can be used during the event only then can provide a report on the outcomes.

GroupMap provides processes, which you can add to any template, to help you in customizing the session workflow according to the objectives and outcomes, Figure (12). Many ideas are generated through these steps which requires filtering them and promoting the best ones. Here are some tools that may help you doing that: Dot vote, like/dislike, sort, rate, score.

Pros of using GroupMap:

- It is a great tool for brainstorming decision-making as it has lots of configuration options for different types of voting, easy to send out a dot vote and track.
- The report that is available is easy to convert to PDF and send without manually typing it all out.

Challenges of using GroupMap:

- It can be used only during the event because it is a real-time platform.
- It is paid and the experience varies according to the price.
- It has limited uses.
- You still need to use an audio or video conference platform because GroupMap does not include voice or video support.
- Admin interface and reporting needs better usability.

In any template, GroupMap offers key features:

- The meeting link: You can always add the meeting link to any template you use, in specific the first widget where there are the map title and objectives.
- Antonymy: You can create an anonymous workplace. This feature creates a safe communication environment that enables participants to share, engage and collaborate. This feature is available in any template under the privacy level option. There are three options (off, partial, full) which you can choose according to the setting and the participants.
- Map chat on/off: to give the opportunity for participants to engage with each other and with the facilitator.
- Reports: GroupMap provides a report after the session with two view options: facilitator only, everyone.

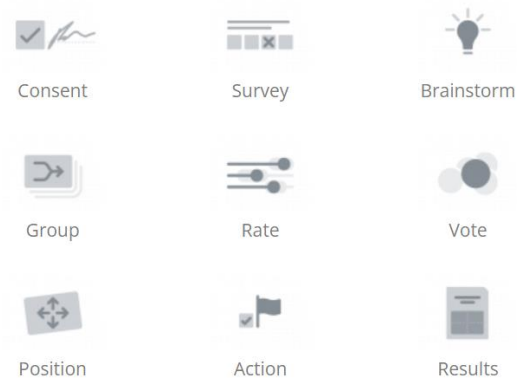


Figure 12 The facilitation tools in GroupMap.

GroupMap templates

Here are some suggestions on how to use GroupMap:

The Blank template:

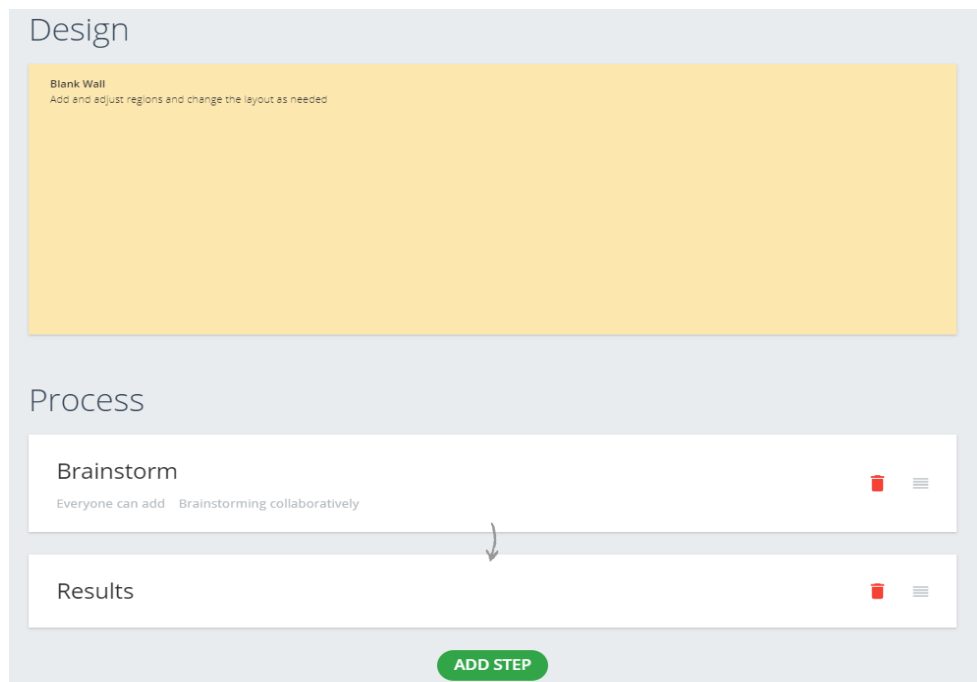


Figure 13 The blank template.

The SWOT Analysis template: The SWOT is a strategic management tool that can be used to conduct competitive analysis, strategic planning, or any other study.

- SWOT template design has four sections: strengths, weaknesses, opportunities, and threats Figure (14). It enables the facilitator to ask questions regarding internal factors (strengths and weaknesses) and external factors (opportunities and threats) then balance them in the given context.
- The process: Figure (15) shows the three steps of the process related to this template.

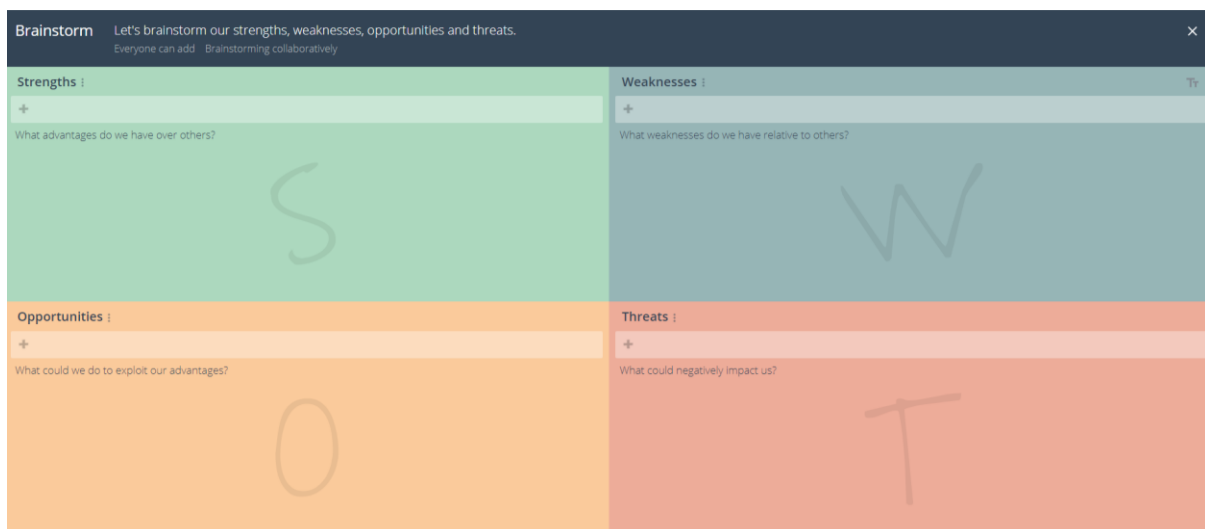


Figure 14 The SWOT Analysis template.

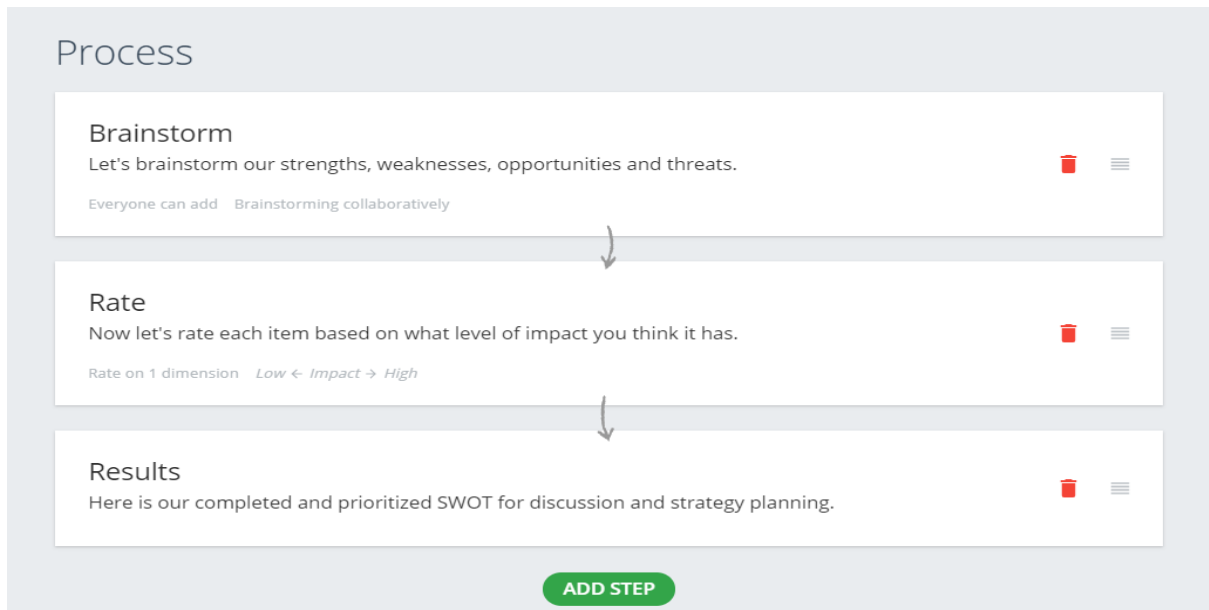


Figure 15 The process in SWOT template.

The PESTLE template: PESTLE Analysis is a strategic framework used to evaluate the external environment of an issue or topic by breaking down the opportunities and risks into Political, Economic, Social, Technological, Environmental, and Legal factors. Water management and water scarcity could be an interesting topic to use as an example.

- The PESTLE template design has six sections Figure (16).
- The process: Figure (17) shows the four steps of the process related to this template.

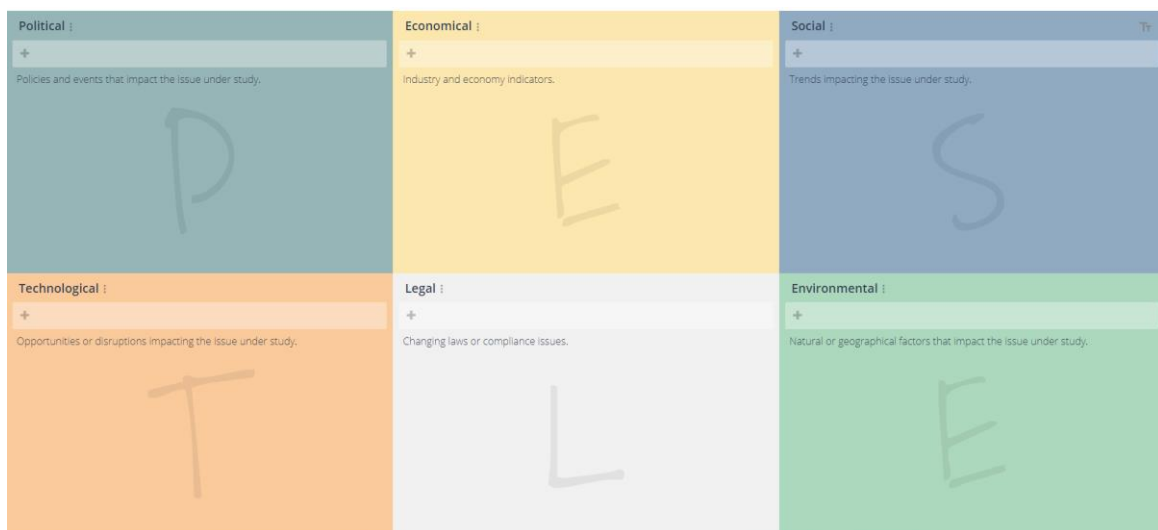


Figure 16 The PESTLE template.

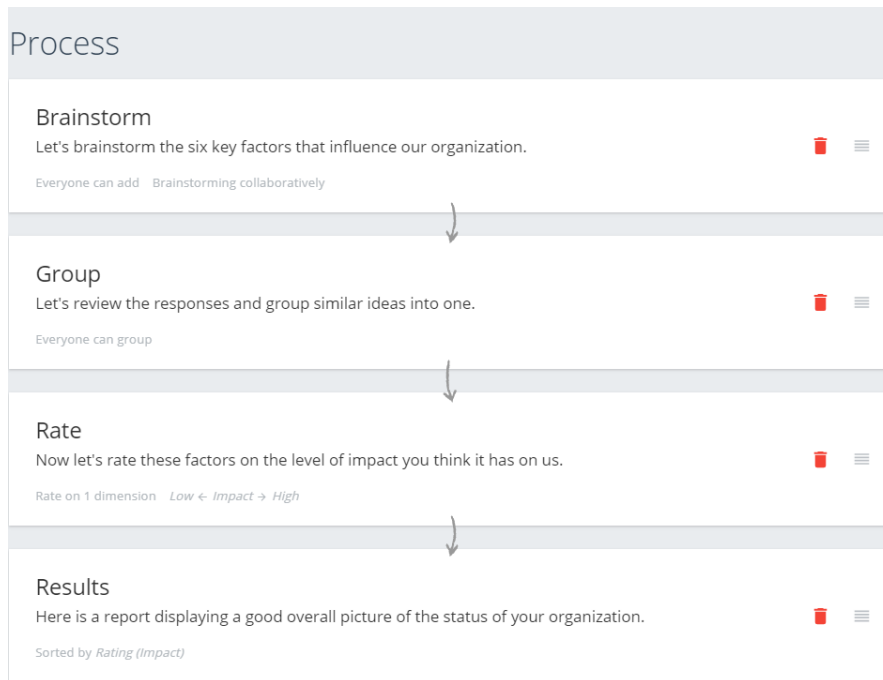


Figure 17 The process in the PESTLE template.

The Risk Map template:

There is a key need to manage any rising risk by planning a risk management strategy and put it into practice through significant actions. This is done by capturing and prioritizing the key risks based on their likelihood and consequence.

- The Risk Map template design is shown in Figure (18) where there are four actions: Detect, control, prevent and monitor according to the impact and likelihood.
- The process: Figure (19) shows the five steps of the process related to this template. The participants brainstorm the risks related to a particular issue, then the facilitator positions them according to the impact and likelihood and finally the participants vote for the highest risks to propose the necessary actions to minimize them.

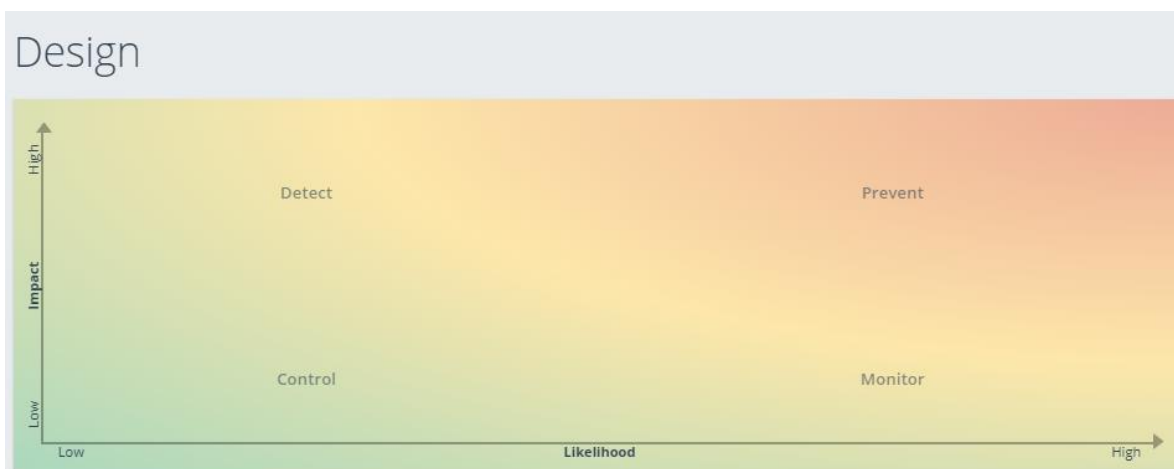


Figure 18 The risk map template.

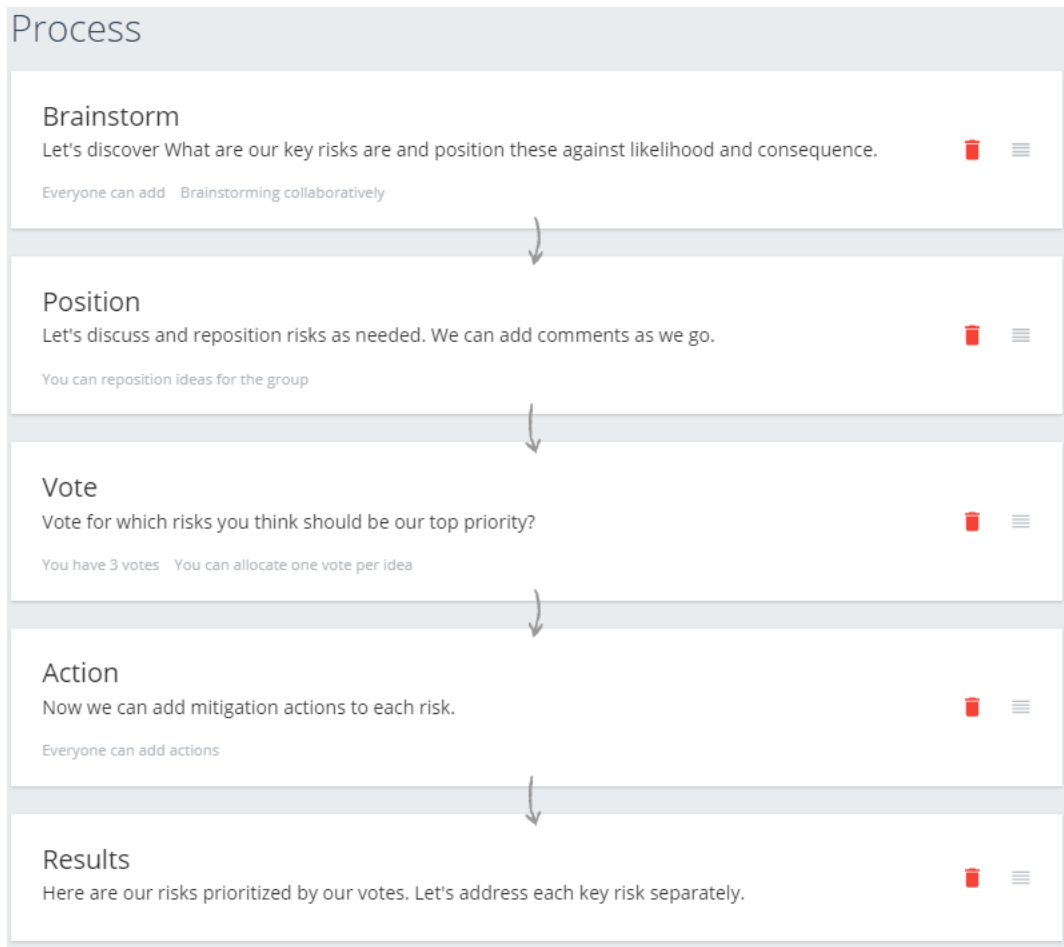


Figure 19 The process in the risk map template.

Stakeholder Map template:

A stakeholder map is a visual, four-quadrant influence-interest matrix used to identify stakeholders and position them in terms of their power and interest Figure (20). Gaining the stakeholders' support is relevant in any context, thus rating each stakeholder based on their level of support (Adversary to Advocate) is a key part of the process in this template then suggesting specific actions to promote the communication and collaboration with them Figure (21).

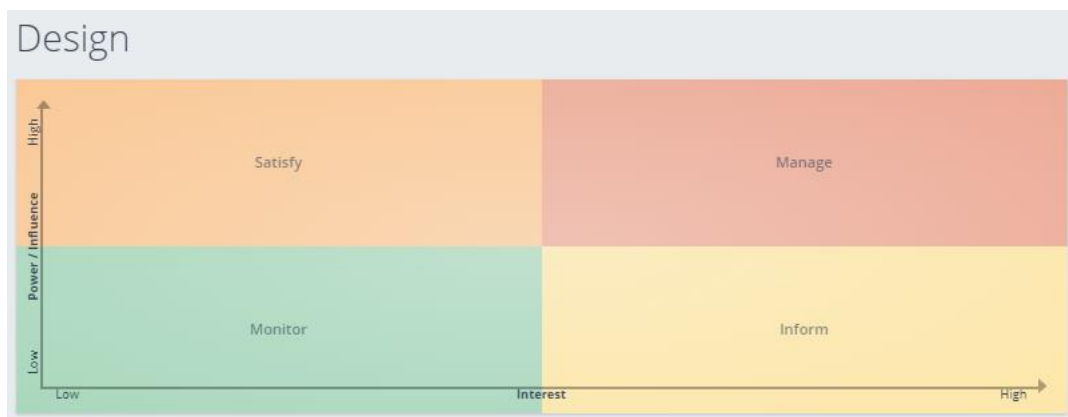


Figure 20 The stakeholder map template.

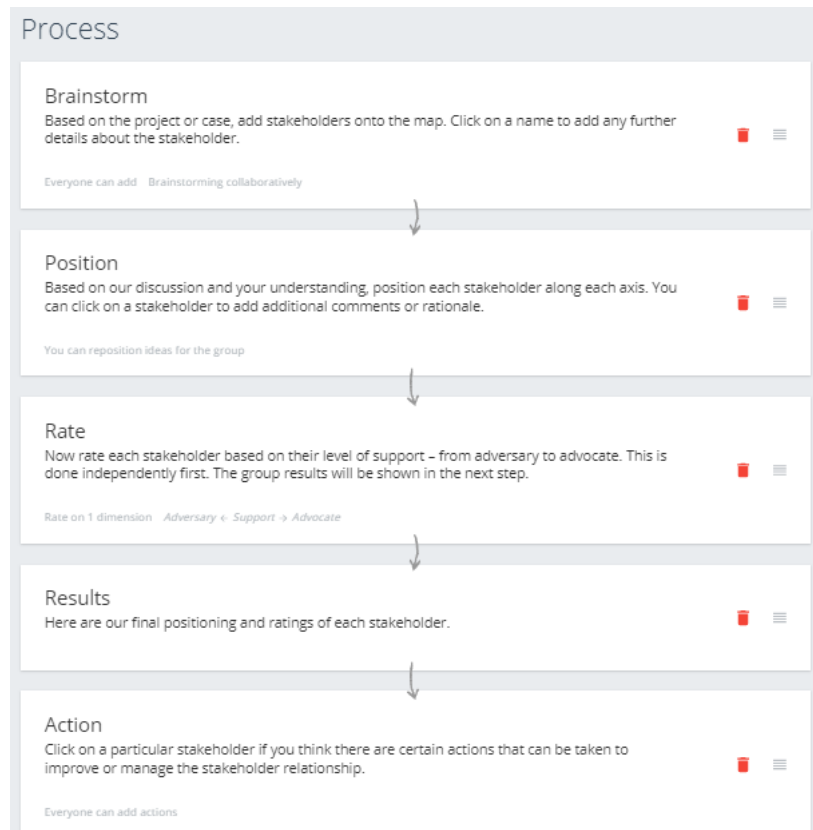


Figure 21 The process in the stakeholder map template.

Some useful links to know more about GroupMap:

- [The Groupmap blog](#)
- [The available templates](#)
- [Groupmap YouTube channel](#)

4.3.2. Digital tools for teaching and learning

[Padlet \(https://padlet.com/\)](https://padlet.com/) is a digital tool that can help teachers and students in class and beyond by offering a single place for a notice board. Students and teachers can use Padlet to post notes on a specific page. The students can post comments and feedback on topics or ideas. Students can use Padlet as a portfolio for a class or program and can use the classroom Padlet wall to post assignments, homework, or active activities for students to complete.

[Quizlet \(https://quizlet.com/\)](https://quizlet.com/) is a web-based application developed to help students study information through interactive tools and games. Quizlet mission is to help students (and teachers) practice and master what they are learning. Quizlet makes simple learning tools to study anything. It can create multiple custom question sets; question sets help students prepare for tests and exams. Students can have fun exploring by using the game formats that Quizlet offers and great for online and hybrid courses to make the material more engaging.

[Google Classroom \(https://edu.google.com/workspace-for-education/classroom/\)](https://edu.google.com/workspace-for-education/classroom/) is a free application designed to assist students and teachers connect, working together, organizing, and creating assignments. It enables learning to be paperless. Google Classroom application is easy to use and accessible from all devices and has effective communication and sharing. The app speeds up the assignment process and has an effective feedback system. There is no need for paper. It has a clean and user-friendly interface, a great commenting system, and is

easy to use. The collaborations can be boosted, and communication can be fostered. The Google Classroom is available on the web or by mobile app. Also, it can be used with many tools that already use, such as Gmail, Google Docs, and Google Calendar. However, accounts are difficult to manage, and it has limited integration options. Further, Google Classroom is too googlish, and there are no automated updates. Also, automated quizzes and tests cannot be created.

[Trello \(https://trello.com/\)](https://trello.com/) is a collaborative tool that supports project-based learning through the digital boards it has. Different boards can be created for assignments, test papers, etc. And in those boards, cards can be created. Furthermore, a particular topic in that card can be discussed. The students can be invited to view that card, and the students can put in comments, doubts, or ask questions and even attach images, videos, etc. Also, students can quickly look at their projects, set deadlines, and track progress online.

[Socrative \(https://www.socrative.com/\)](https://www.socrative.com/) is a quiz-based, formative assessment tool with multiple features that can enrich teaching and learning. That is a formative assessment tool that helps teachers and learners to assess understanding and progress in real-time in class using quizzes, questions, and reflection questions. Socrative is a free, fast tool that can access from mobile and tablets via a web browser. It is available in IOS and Android. Immediate interactions can be launched in Socrative. Creating quizzes is easy and can be shared easily between teachers too. The results can be exported, and students do not need to be registered. However, there are no multiple response questions, and the task has to be limited to fifty students per course. The license is not free, and the language is English.

[Kahoot \(https://kahoot.com/\)](https://kahoot.com/) is a game-based learning platform that brings engagement and fun to students. It uses to create a learning game or trivia quiz on any topic, in any language, and deliver training, presentations, meetings, and events in-person or on any video conferencing platform.

The questionnaire module allows constructing surveys using a variety of question types to gather data from users. [Google Forms](#) uses to easily create and share online forms and surveys and analyze responses in real-time. It is not only for questionnaire surveys, but it can also further be used for tests and quizzes for students.

[SpeedExam \(https://www.speedexam.net/\)](https://www.speedexam.net/) is an online exam system for all the testing needs for assessment, recruitment, selection, and certifications. SpeedExam can be used for instant exams, created, and served in one minute. In addition, the tool has the option of quickly uploading all types of questions and candidate lists from Excel or Word file for online testing and analyzing exam results, creating instant reports and certificates. However, the number of users is limited, and the functionality of each license is different in SpeedExams. Furthermore, the teacher faces the difficulty of finding specific questions. However, the tool can be used for creating; delivering exams and managing question feedback.

[Edmodo \(https://www.edmodoworld.com/\)](https://www.edmodoworld.com/) Edmodo is a very convenient and easy-to-use educational tool that teachers and students prefer for online studies. It connects all the teachers and students and is assimilated into a social network.

This online tool allows the teacher to create online collaborative groups, monitor and upload educational materials, measure each student’s daily performance, and communicate with the parents of every student, among tons of other innovative functions.

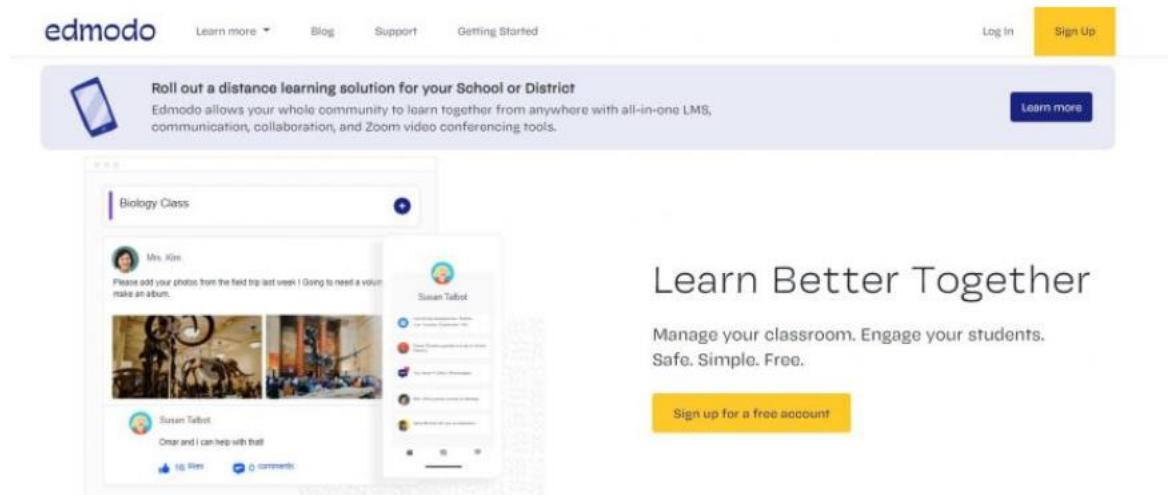


Figure 22: Example of Edmodo

Edmodo (Figure 22) is a widely used online tool for online teaching and hence, has more than 34 million users who connect on this app on a daily basis. It helps the teachers and students to create a learning process that is more polished, personalized, and aligned with the facilities brought by the advancement in technology and the digital environment.

[Mindomo \(https://www.mindomo.com/\)](https://www.mindomo.com/) Mindomo is one of the best and most useful mind-mapping online tools for online teaching. It can administer and keep a record of all the ideas, strategies, and plans made by the teachers and students.

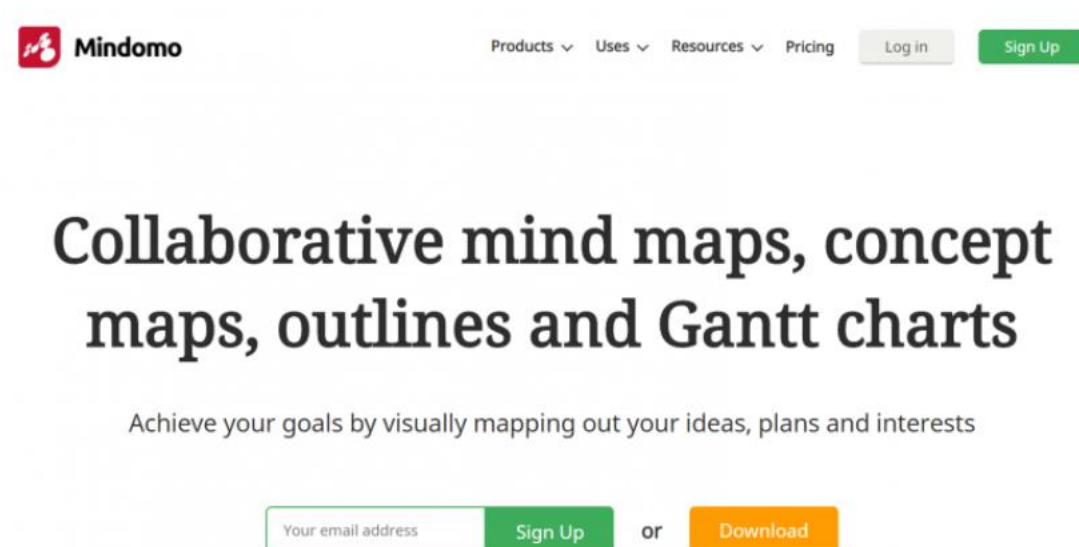


Figure 23. Mindomo website

It does so through a proper working layout with additional features such as attachments, links, media, videos, images, etc. Due to its distinguishing sync feature, you can easily manage your work even if you are in offline mode.

This online tool which can also be called a mind-mapping application is an efficient strategy for both the students and teachers in online teaching. Its cutting-edge features and functions make it one of the bests when it comes to real-time brainstorming and structuring ideas, strategies, and plans.

[Google Hangouts](https://hangouts.google.com/) (<https://hangouts.google.com/>) mostly concerns itself with group online tutoring discussions or sessions. Google Hangouts, on the other hand, works equally well and is accompanied by a lot of striking features such as scheduling group sessions in advance, recording a lecture, allowing that lecture to be re-watched whenever you are free, etc.

This online tool makes sure that the student does not fall behind even if they fail to attend a few lectures. They also do their best to bridge the communication gap between the teacher and the students with several of its funny and engaging features.

[Basecamp](https://basecamp.com/) (<https://basecamp.com/>) is one of the best user-friendly assignment management tools that you can get your hands on. It is widely used by many English teachers and students all over the world.



Figure 24. Basecamp starting page

It has an immensely powerful search option that is capable of searching all your projects, assignments, activities or tasks that you may be in need of. This is possible because of the way everything is organized so excellently within the app. Another cool thing that is worthy of mentioning about this tool is the centralization.

Basecamp helps you stay on top of the task with no efforts because it connects everyone who is involved in the discussion automatically. This means that you do not have to personally call everyone up and discuss things to get the task done. Instead, you can easily communicate with all your classmates (and for teachers, your colleagues) with the help of this tool.

[Baiboard \(BaiBoard – edshelf\)](#): Virtual Whiteboards are an essential item in online teaching. One of the online tools that give you similar facilities is Baiboard. It is best suitable for 1–1 or group tutoring discussions/sessions if you have an iPad.

However, if you are on a Windows or Android tablet, Idroo is the online tool that you are looking for. Apps like these come in handy for subjects like science and math where it is critical to depict the experience of sitting next to a student, crowded around a single exercise on paper or in a book, and helping him to solve a problem.

This is not possible when the only tools at our disposal are the keyboard and mouse. It gets really tough and clunky to scribble math notation on a problem set with a mouse. But now with the introduction of the iPad (and other tablets) and a host of networked virtual whiteboard apps, everything has changed.

Baiboard is free for unlimited use by students and teachers. It is excellent for organizing group sessions/discussions, as it can accommodate up to 40+ participants on the same call at once. It also offers other facilities like iPad-to-browser sharing, so that the students are free to participate from anywhere.

4.3.3. Digital tools for developing presentations and videos

Mentimeter (<https://www.mentimeter.com/>) is used to build interactive presentations with the easy-to-use online editor. Add questions, polls, quizzes, slides, images, GIFs, and more to the presentation to create fun and engaging presentations. Interactive presentations can be created in the presentation builder. Various interactive question types can be built, including Word Clouds and Quizzes, and the entire presentations can be built quickly and easily with Content Slides. Different presentation themes can be selected or can create a presentation according to the requirement. Free stock image and GIF libraries can be integrated. Mentimeter has an easy-to-use presenter mode. The audience interacts anonymously with a smart device. Further, it can use to collect and analyze data taken from participants using smart devices. The tool includes several options such as live polling, word cloud, quiz, questioning and answering, survey, and presentation.

Slido (<https://www.slido.com/>) is an audience interaction platform that helps users get the most out of meetings and events by top crowdsourcing questions and engaging participants with live polls and quizzes. Slido is used for large enterprises and education for Live polls, question and answering, quizzes, and live video integrations. It has solutions for remote meetings, hybrid meetings, virtual events, and webinars conferences. Further, it is integrated with the resources, Blog, Better Meetings Guide, Use cases, Webinars, Videos, Help Center, and Documents. The students can engage via polling and PowerPoint, and Webex integration is in Slido. However, Slido requires a chat feature, especially when using Webex Events, so attendees only have one app to communicate with event hosts and panelists. Short videos can be created for a flipped classroom and explain assignments and test preparations. In addition, lesson content can be previewed with a short video the students can watch beforehand, so the students come to class prepared.

OBS Studio (**Open Broadcaster Software**) (<https://obsproject.com/>) is a free and open-source software for video recording and live streaming. It helps create scenes of multiple sources,

including window captures, images, text, browser windows, webcams, capture cards, and more. OBS studio can easily stream to both social media and other streaming platforms and offers a wide range of features for screencasting. Furthermore, it customizes the quality of capture, sets the resolution as per requirement, or uses the resolution of the monitor. Also, the streamlined settings panel gives access to a wide array of configuration options to tweak every aspect of broadcast or recording. However, the OBS tool can intimidate novice users, and it is not available on Android.

Powtoon (<https://www.powtoon.com/>) is a visual communication platform that gives the freedom to create professional and fully customized videos. Powtoon uses for making videos, animated videos, whiteboard doodling, screen recordings, presentations, and custom characters. Further, Powtoon presentations can be a built-in slideshow or movie forms. Various pre-made templates are available, video animation can be shared via a public link, and the animated presentations can be downloaded as PDF or PowerPoint PPT files. Ready-made templated are available, and it is not hard to use and can be easily shared with the public. An offline version of the animated video can also be saved, and the work saves automatically. However, as a limitation, the Powtoon presentations have a watermark and difficulty viewing others' presentations because of the long loading time. Further, several options and features are only available in a paid subscription.

4.3.4. Flipped model in blended learning

This blended learning model allows trainers to prioritize active learning during class time by giving learners the training materials and presentations before the actual class. Then, the trainer can share the content via a learning management system (LMS), email, or however training is delivered.

Moodle (<https://moodle.org/>) is a free and open-source learning management system developed on pedagogical principles. Moodle is used for blended learning, distance education, flipped classrooms, and other university e-learning projects. With customizable management features, Moodle is used to create private websites with online courses for educators and trainers to achieve learning goals. In addition, Moodle allows extending and tailoring learning environments using community-sourced plugins. Moodle is a free platform that is compatible with any browser. The limitations of Moodle are the unavailability of new features compared to other platforms, complex environments, fragile security, and little internet service downtime to avoid continuous functionality.

BlackBoard is a popular teaching tool that comes with numerous capabilities. Teachers can easily administer tests, monitor performance, manage syllabus, and even upload grades. The hassle of writing everything on paper from an aching wrist can be avoided. Students can equally benefit from this tool because they can access all the information upload on the platform, including grades, assignments, and attendance. The best part is that all this comes on one platform. Therefore, multiple applications are not needed to manage it all.

4.4. Simulation programs for water management and water utilities

Numerous simulation programs exist for water resource management and water treatment facilities simulation. While these tools were introduced as stand alone modelling and simulation tools, it is likely that they will be integrated into Digital Twins in the near future.

Need and benefits of simulation tools:

- A decision making tool
- Provides a basis for design alternatives reducing need for physical tests - avoids costly mistakes in full-scale
- Plant operators may simulate operational conditions for process optimisation
- A learning tool for plant operators, students
- Researchers and Consultants: wider opportunities to find more economical and efficient process alternatives
- Guidance under extreme conditions

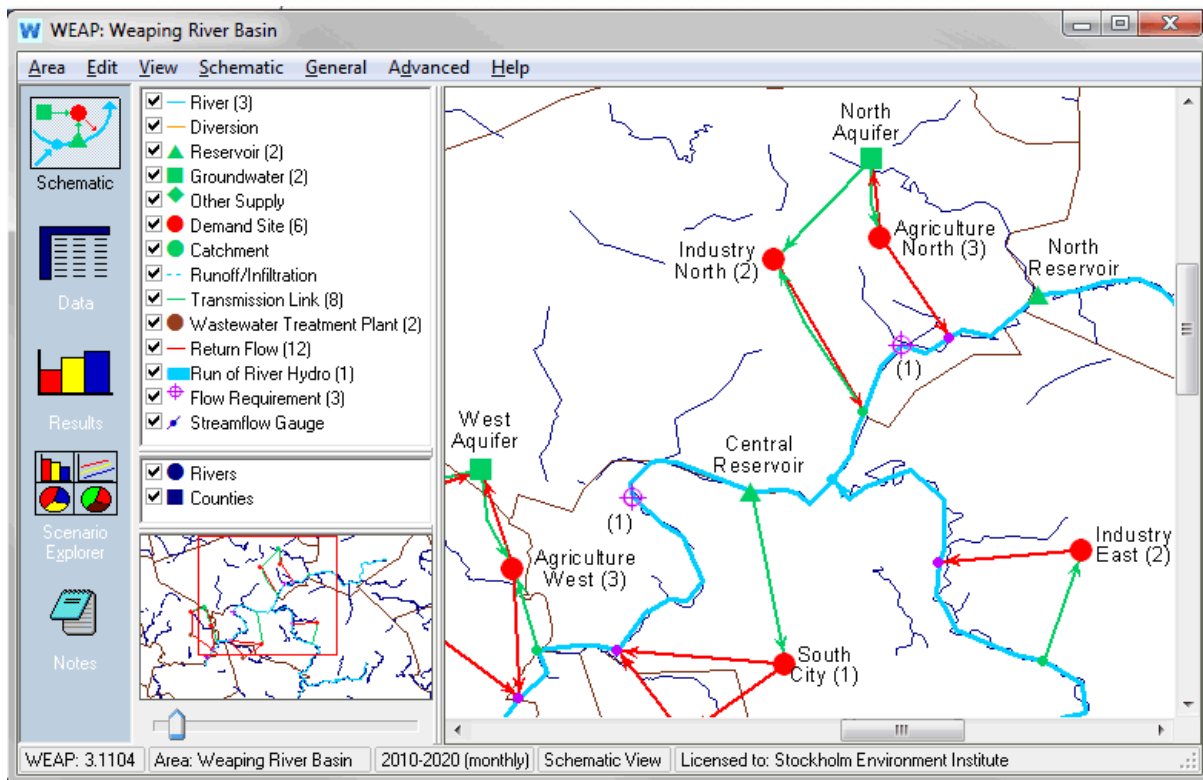
WEAP (Water Evaluation and Planning System) www.WEAP21.org: WEAP is probably the world's most widespread program for integrated water resources planning that attempts to assist rather than substitute for the skilled planner. It is a comprehensive, flexible and user-friendly framework for planning and policy analysis. Over 50 000 water professionals are finding WEAP to be a useful addition to their toolbox of models, databases, spreadsheets and other software.

Main functions:

- **Water balance database:** WEAP provides a system for maintaining water demand and supply information.
- **Scenario generation tool:** WEAP simulates water demand, supply, runoff, streamflows, storage, pollution generation, treatment and discharge and instream water quality.
- **Policy analysis tool:** WEAP evaluates a full range of water development and management options, and takes account of multiple and competing uses of water systems

Examples of possibilities:

- What if population growth and economic development patterns change?
- What if reservoir operating rules are altered?
- What if groundwater is more fully exploited?
- What if water conservation is introduced?
- What if ecosystem requirements are tightened?
- What if a conjunctive use program is established to store excess surface water in underground aquifers?
- What if a water recycling program is implemented?
- What if a more efficient irrigation technique is implemented?
- What if the mix of agricultural crops changes?
- What if climate change alters demand and supplies?
- How does pollution upstream affect downstream water quality?
- How will land use changes affect runoff?



Figures 25. Example screen of WEAP

[Water and wastewater treatment plan simulation software](#)

[Innovative - Version Visual Hydraulics 4.2 - Flexible Hydraulics Modeling Tool for Water and Wastewater Management](#)

Visual Hydraulics is a state of the art, flexible modeling tool. It is used primarily for modeling the hydraulic characteristics of water and wastewater treatment plants, and is capable of analyzing entire hydraulic profiles. The software follows the traditional method for analyzing water surface profiles: a downstream control point is selected, and the hydraulic profile is then determined.

[Aqua Aero - Version 3.0 - Software for Design of Aeration Systems](#)

The aeration system is the most important equipment of a wastewater plant. 75% of the energy used for the wastewater treatment is covered by the aeration system. The correct design of the aeration system is the basis for a good operation and the operational costs. As the energy costs are the main cost value of an aeration system, a real comparison of different systems must concern both the operation and the invest costs of the whole life cycle.

[Aqua Designer - Version 9.1 - Software for Design of Wastewater Treatment Plants](#)

AQUA DESIGNER is a software tool for the design of several processes of a wastewater treatment plant, from mechanical treatment via biology up to sludge treatment. Regarding the basis of calculation, the process and the construction all common process variations are to choice. Planning is supported by many auxiliary functions

[SIMBA#water - Version 5.0 - Modelling and Dynamic Simulation in Wastewater Technology Software](#)

The current version 5.0 of SIMBA# brings many improvements in the user interface and in the numerical properties of the simulation kernel but above all many model extensions. The most important changes

are listed in the release notes. Implementation of the DWA volume T4/2016 "Design of sewage treatment plants in warm and cold climate zones" presents more details.

[SIMBA#water - Version 5.0 - Process Simulator for Modeling, Simulation, Optimization and Management of Wastewater Treatment Plants](#)

SIMBA#water is a process simulator for modeling, simulation, optimization, and management of wastewater treatment plants and beyond. It provides process simulation capabilities for sewers, wastewater treatment plants.

[Innovative - Visual Hydraulics and Visual Water Designer Modeling Software Packages](#)

In addition to our Visual Hydraulics and Visual Water Designer modeling software packages, Innovative Hydraulics also provides custom hydraulic model development and advanced Computational Fluid Dynamics (CFD) modeling. We have created specialty models for a variety of clients and have used our CFD modeling capabilities to analyze various unique flows.

[Water and Water Treatment Reporting Software](#)

Water, and water treatment reporting is becoming more important as organisations broaden the scope of their Environmental Management practices. Good reporting is just as important as for fossil energy accounting.

[ServiceTitan - Water Treatment Software](#)

Water treatment software automates your company's day-to-day operations—from scheduling and dispatching to sending estimates and invoices—for better efficiency and increased net profits. This all-in-one field management solution allows your water treatment company to track and record every call, customize reporting, and easily communicate via a mobile app with the operational staff, etc.

[SWT - Version CAS-10.1 - Denitro-Nitro Calculation Software](#)

CAS - Traditional Biological Treatment with Activated Sludge in Denitro-Nitro basins (CAS) [urban waste water or similar.

[Ovivo - Version Industry 4.0. - Automation Software of Water Treatment System](#)

The level of automation which is brought to Ovivo water treatment systems delivered to customer site allows us to slowly be prepared for the next largest industry change which is Industry 4.0. Most of our systems are connected to long term data storage archives and they collect thousands of process data's which can be utilized for plant optimization and predictive control.

[WWTP/Check - Tool to Determine the Residual Treatment Ability \(RTA\) and the Aeration Energy Saving \(AES\)](#)

In relation to the growing attention to issues of process efficiency and energy optimization under the wastewater treatment, linked both economic issues and rules, this introduce the software code WWTP/Check to determine the Residual Treatment Ability (RTA) and the Aeration Energy Saving (AES).

[Version GPS-X - World-Class Wastewater Simulation](#)

Make wastewater facility design more efficient, and evaluate every option. Hydromantis is the home of GPS-X, renowned as the world's premier wastewater treatment plant simulation and optimization application. GPS-X is a modular, multi-purpose computer program for the modeling and simulation of municipal and industrial wastewater treatment plants.

[LewaPlus - Version 5.0 - Ion Exchange Calculation and Design Software](#)

New state of the art LewaPlus software design tool for Ion Exchange and Reverse Osmosis membrane systems. The current Lewatit 5.0 design software will now become a core part of a more comprehensive design tool for water treatment applications. This new and more comprehensive software has been designated LewaPlus.

[OPTImaster - Software for Wastewater Treatment Plants](#)

Solves operational problems and achieves energy savings of up to 25 percent by selecting optimum DO and SRT targets. OPTImaster automatically selects DO and SRT targets, solves operational problems, and achieves energy savings of up to 25 percent. OPTImaster is a software program, which provides daily recommendations for sludge age (SRT), mixed liquor total suspended solids (MLSS) concentration, etc.

[BLANKETmaster - Software for Wastewater Treatment Plants](#)

Improves plant reliability, reduces pumping costs, and increases biogas production by maintaining a constant depth of sludge blanket in clarifiers and gravity thickeners. BLANKETmaster improves plant reliability, reduces pumping costs, and increases biogas production. BLANKETmaster is software that automatically maintains constant sludge depth in primary and secondary clarifiers, etc

[hyd-RO-dose - Water Treatment Modeling Software](#)

hyd-RO-dose modeling software gives treatment personnel an unbiased mineral scale and inhibitor modeling tool for reverse osmosis systems. Evaluate an entire operating range for 20+ scale forming species and select appropriate treatment for optimal performance.

[Organica - Process Control Software](#)

As part of each Organica FCR WWTP, Organica supplies and installs its process control software, custom programmed to operate the WWTP efficiently and in an automated way. Organica utilizes a PC-PLC based process control system, integrating the acquisition, display, and storage of operational data, as well as the input and application of operational .conditions.

[SWater Pro/Mix - Wastewater Treatment Plant Simulation Software](#)

Testing, Upgrading and Simulation Software Tool for Urban and Industrial WasteWater Treatments Plants. With reference to a more than ten-years operative training and testing of the previous version SWater Pro, the well known MultiFunctional Testing & Upgrading Software Tool for Urban WasteWater Treatments Plants (WWTPs),

5. Highlighting best practices and outlining lessons learned

5.1. Best practices to promote innovation and bridge the gap between academia and industry

The current status of digital water transformation in academia, government and business is considered to be at a moderate level. There is a need for better training of specialists in the field of water, as well as candidates for positions in this field. Advanced monitoring technologies and smart equipment are largely needed to transform data into a digital format. Thus, in order to increase the digital transformation of water in these sectors, the involvement of the educational sector is very important. The following actions should be considered as priorities:

- Increasing the level of staff training in support of digital water transformation in general seems to be higher in the Academy and Enterprise sectors.
- It is necessary to develop a strategic water education plan, modifying the curriculum from primary, secondary and college education. Within the study disciplines, water and information technology should be interconnected, thus achieving transition to the transformation of water digitization.
- Development of guides of good practices and behaviors in the field of water based on the development of new databases and new methodologies for their use starting from universities and their laboratories. Development of data platforms of processes that can be used in education, thus involving the education sector in the real issue of water systems.
- Use of geographic information systems, simulation tools and sensors in teaching issues. Completing the curriculum with topics that include new virtual reality technologies and artificial intelligence applied in the field of water.
- Involvement of students in EU funded projects such as Citizen Science by Students with a focus on the water sector.
- Inclusion in projects of separate work packages regarding education for the water sector.
- Initiating discussions in schools and universities with pupils and students mainly, using global and digital area to attract the students and to transmit the information
- within educational systems.
-

Increasing the level of cooperation between different sectors has an important role in achieving the digital process of water transformation. This can be achieved through free access to environmental data as well as by sharing data and their availability. The actions required are the following:

- Development of a common environmental data collection platform, which can be managed by a public-private consortium.
- Establish anonymous sharing data systems to avoid conflicts with data confidentiality requirements, by selecting representative data samples. A data taxonomy and a priority of the first data sets for sharing must be defined.
- Defining requirements for data sharing at product, manufacturer, brand level. Development of data platforms as a result of local initiatives that can then be connected to national and even industrial level platforms.
- Defining a legal framework for data sharing.
- Develop funding mechanisms to enable the creation of open databases with free access for citizens.

- Establish well-defined data governance procedures.
- Communicating open data policies and providing incentives, promoting business model prototypes based on Data sharing.
- Identify use cases involving cross – domain objectives and datasets.
- Generalize the publication of standardized APIs for data access, identification of data sources and data markets, collaborate with open data experts between sectors.

Planning and implementing an efficient digital transformation strategy will lead to benefits for each sector of activity. The actions designed in this case are:

- Creating a secure, multi-user data sharing platforms.
- Development of goal-oriented guides, integration of IT skills with the hydraulic ones at the level of education.
- Promoting Living Lab demonstrations and laboratories to increase confidence and trust.
- Promoting the use of digital solutions as a cost-effective strategy, the need for a cost benefit approach to encourage digital adoption.

5.2. Best practices for successful teaching and training while promoting students' engagement

The basis of a successful teaching act lies in the strong emphasis on content (what are the core concepts that we want our students to learn?), pedagogy (what is the most effective way for the students to take all in and how do we want them to interact with the material?) and assessment (how can we best assess their understanding of the material?) which translates into:

- Clear expectations drawn with a detailed syllabus (you have a number of weeks allocated to the course therefore you have the same number of titles. The titles should be insightful.)
- Due dates and schedule (the schedule is constructed considering the weeks allocated to each course. The planned content of the course is then broken down into learning objectives which are attained via assignments clearly established with due dates).
- Clear assignments directions (the careful planning of the learning objectives, of the assessment and assignments translates into clear and precise directions intended to ease the knowledge acquisition process and result in completing successful tasks).
- Learning objectives (make sure that the course content is aligned with the objectives and the assessments. The content which is not directly supporting the learning objectives is to be removed or indicated as optional).
- Keep in mind the feedback (emphasize the important materials and concepts and incorporate timely feedback throughout the course).
- Be mindful of the online delivery of the course (divide the learning/teaching into smaller chunks with patterns of activity and due dates; describe the expectations in terms of online participation, communication and the netiquette; provide technical support and information).
- Engage the students (well thought educational experiences that are challenging become enriching and cultivate the academic abilities and also stimulate the interaction between students; create opportunities, through discussions and group work, for the students to interact with their peers).

- Keep in mind the real world (students need to constantly be motivated through connections with the real world, therefore they need guidance into discovering how the acquired knowledge is actually applied).

To increase the engagement of students, the educator can follow the following tips: can enhance the engagement by:

- Anticipating potential learner's questions regarding the material,
- 'Reading the room' using questionnaires, polls or other interactive technologies, thus
- Accessing the experience, comprehension and the reaction of the students.
- Inviting the students to answer questions that are well-thought and prepared in advance so as to provide the most understanding and challenging.
- Open the floor to general discussion and create 'buzz groups' conversations via breakout rooms.
- Use tools like Google Docs, Miro etc to create opportunities for synchronous and asynchronous student collaboration.

For delivering your lecture consider the following:

- Create a script of your lecture where everything is well fitted into time sequences, including the time allocated for group discussions or collaborative work between students.
- Practice makes perfect – if possible, try to practice, at least once, in advance as you need to juggle with a lot of features of the online teaching platform such as switching between the presentation mode, screen share mode, slides and other materials, whiteboard, questionnaires or videos.
- Be explicit in the transitions you make between activities and the discussion topics and avoid chaos.
- Be mindful of your pace and constantly keep an eye on the students' comprehension and engagement.

When planning the online learning, consider that not all students are able to attend the online class and be prepared for potential technical difficulties. Thus, recorded and pre-recorded materials can help. "Although they are time consuming, creating pre-recorded lectures allow you to edit the recordings and integrate graphics and animations. They prove themselves extremely useful when the live sessions experience unexpected bandwidth problems. Here are some tips on how to organize your pre-recorded material:

- Outline the content you intend to cover.
- Break down the lecture into shorter segments of no more than 3-5 minutes.
- Intersperse the lecture clips with reflection questions, polls, action prompts and other interactive elements. Keep in mind that the experience should be inductive rather than entirely didactic.
- Add your personal touch – a personal story, humor, or editorial commentary.

The pre-recorded material can beautifully complement the live session, therefore, consider pre- recording certain segments of your lecture (some material you want the students to reflect upon before the class, or an explanation of key terms or concepts) and leave the rest for the synchronous sessions". (teachremotely.harvard.edu)

5.3. Best practices for online supervision

For connecting:

- Initiate and schedule the first meeting in the online environment, even in the case of pre-existing relationships.
- Establish a convenient common time across time zones (if applicable) that works for both supervisor and students.
- Identify a mode of communication (for example, telephone, audio conference, or video conference) for the meeting that both supervisor and student are comfortable with, and that takes into account the technology access for both (for example, if bandwidth availability is a problem for either candidate or supervisor, it might not be possible to hold a quality video conference and an audio conference would be more conducive to avoid technical problems during the meeting).
- Establish and communicate 'virtual office hours' at regular intervals (for example, weekly or bi-weekly) and identify a permanent virtual location (for example, Zoom link) where the supervisor will be available

For communicating:

- Initiate and lead online communication at least for the first few months of the online supervisory relationship. As students become more comfortable with supervision and the research process, consider a gradual transfer of responsibility for communication to the candidate.
- Schedule online meetings with students at least once a month. In the initial phases of research or to build a relationship with the candidate online, more frequent meetings might be needed.
- Choose and use technologies based on the goals of the meeting (for example, if discussing data analysis, a technology that enables screen sharing might be needed) and access to technology at that time. This can change during the process based on the location of the supervisor and student.

For building a relationship:

- If at all possible, try to meet face to face with the student early and lay the basis for your future relationship.
- Be aware that, as well as formal communication, informal communication and humour can help to build relationships and establish trust.
- Take time to get to know the personal circumstances of your students and to understand how these might impact upon their studies.
- Be flexible, encouraging, and ready (literally) if things become too pressured, to suggest a break.
- In the case of students from other countries, find out about social and cultural differences and take these into account when communicating with candidates.

For understanding expectations:

- Ensure that your doctoral candidate has an induction into the institution, its policies and procedures, the programme, and research resources.
- Spend time at the start of the relationship with the candidate developing a mutual understanding of your respective roles and responsibilities.

- Consider formalising this via an agreement or learning contract.
- Identify milestones for the research project and regularly review progress towards them.
- Set deadlines for sharing drafts and giving feedback.
- Put candidates in touch with further advanced candidates to discuss candidate and supervisory roles.

For designing and implementing the research project:

- Be prepared to assess whether doctoral candidates possess the basic research skills and, where appropriate, support them to acquire them.
- Be able to provide 'scaffolding' in the early stages to help candidates to build their projects.
- Take advantage of videoconferencing software that enables screen-sharing (for example, Skype, Zoom) for discussions pertaining to data and data analysis.
- Remember that research setbacks can seem less surmountable by online candidates and be prepared if necessary, to intervene.

For Producing Writing:

- Start off small and build up to larger pieces of work.
- Provide examples and exemplars of good writing in the discipline(s).
- Discuss writing conventions in terms of citation and referencing.
- Encourage the use of bibliographic software (for example, EndNote, Refworks) for the use of in-text citations and references while writing.
- Where appropriate, refer candidates to institutional sources of support for academic writing.
- Offer advice on writing strategies.
- Establish peer support groups to facilitate writing.
- Provide opportunities for candidates to disseminate their work and receive feedback, for example, online journals, journal clubs and research conferences.

For Giving Feedback:

- Discuss the provision and reception of feedback with your candidate.
- Remember that feedback has emotional connotations, and structure it accordingly.
- Keep the bigger picture in mind and not just the spelling and grammar.
- Respect the candidate's identity as a writer.
- Accept that candidates have the right to disagree.
- Follow up asynchronous feedback with synchronous feedback.
- Always feed-forward as well to enable your candidates to act on your feedback.

For isolation:

- Create a group email or social media group to share resources and disseminate information among a group of candidates.
- Organize virtual group meetings of candidates at different stages of the thesis/dissertation process to share their work.
- Establish an online portal for resources and documents common to the research group.

- Meet at a seminal annual conference (if possible) to enculturate candidates into the discipline and research community.
- Encourage candidates to connect with leading scholars on social media relevant to their discipline (for example, Twitter, LinkedIn).
- Encourage candidates to participate in activities by leading professional organizations in their discipline.
- Encourage candidates to, if possible, engage with researchers you know of in their field in local institutions.