New Perspectives in Science Education
International Conference
NEW PERSPECTIVES in SCIENCE EDUCATION

Innovative Teaching with Actionbound: Digital Pathways in Chemistry Education A Practical Example from Com^{e}Net Chemistry in the Com^{e}MINT Project

David Weiser[1], Rebekka Ditter[1], David Ditter[1], Karin Siepmann[1], Rebecca Grandrath[2], Sabine Fechner[3], Katrin Sommer[4], Claudia Bohrmann-Linde[2], Isabel Rubner[1]

University of Education Weingarten, Germany[1]
University of Wuppertal, Germany[2]
Paderborn University, Germany[3]
Bochum University, Germany[4]

Abstract

As part of the BMBF-funded Com^{e}MINT project, conditions are being developed for the success of teacher training to improve digital literacy. In the sub-groups, the so-called Com^{e}Nets, adaptive training modules are being developed, tested and iteratively optimized. The subproject Com^{e}Net Chemistry focuses on topics such as digital learning environments, AR/VR, explanatory videos, digital data acquisition and the potential of AI. In addition to a general presentation of Com^{e}Net Chemistry, this article provides an insight into a specific teacher training module.
As an example, a training module using the Actionbound app as a digital learning environment is presented. Based on the concept 'Aquaville and the secret of Aqua Cristallo', the participants learn in a practical part how Actionbound can be used for interactive, experimental and practical learning units in chemistry lessons. The theme of water and its importance in the context of sustainability (SDG 6: Access to sufficient water of good quality) provides the content framework. In the workshop, teachers will get to know the many features of Actionbound and learn how to combine digital sensors with the app. A special focus will be on the differentiation possibilities offered by the integration of switches, which allow for flexible adaptation to different learning groups.
The workshop shows how digital tools like Actionbound can enrich chemistry lessons while simultaneously promoting important digital skills. It offers teachers practical insights and suggestions for integrating digital learning environments into their lessons.

Keywords: *digital media, teacher training, actionbound app, innovative chemistry teaching*

1. Com^{e}Net Chemistry in the Com^{e}MINT Project

The Com^{e}MINT project (Training through Networking - Networking through Training) is part of the national initiative Lernen:digital. It is one of six major projects funded by the German Federal Ministry of Education and Research (BMBF) to develop innovative training concepts for teachers. The focus is on strengthening digitalisation-related skills in the STEM subjects (mathematics, computer science, natural sciences and technology).
Com^{e}MINT follows an interdisciplinary approach in which 14 teacher training universities from different federal states work together. The project builds on the experience of the previous Com^{e}In project, which laid the foundations for the development of further training modules and cooperation structures [1].
A central element of Com^{e}MINT is the establishment of community networks (Com^{e}Nets). These networks are made up of experts in different STEM subjects who work together across locations to develop adaptive, interdisciplinary training modules. The networks are guided by the principles of design-based research (DBR) to achieve scientifically sound and practical results through iterative improvement processes.
Com^{e}Net Chemistry is one of the Com^{e}MINT networks. It is located in Bochum, Paderborn, Weingarten and Wuppertal and focuses on the promotion of digitalisation-related skills in chemistry education.

1.1 Goals and Approaches

The main objective of Com^{e}MINT is to develop and test training concepts tailored to the specific requirements of modern teaching and learning scenarios. Particular areas of focus are

- **Promoting digital literacy:** The modules are designed to enable teachers to integrate digital technologies such as AI, virtual learning environments and digital data acquisition into the classroom in a didactically meaningful way.
- **Sustainability and inclusion:** Cross-cutting issues such as Education for Sustainable Development (ESD) and inclusion are consistently considered to promote sustainable thinking and action and to break down barriers.
- **Transfer and dissemination:** The concepts developed will be disseminated through training centres, conferences and digital platforms to ensure widespread use.

Com^{e}Net Chemistry develops training modules to support teachers in the practical use of digital media. The modules combine face-to-face formats with hybrid and asynchronous elements to support individual learning pathways.
Examples include

- Designing interactive learning environments using tools such as H5P, Genially or Actionbound,
- the integration of escape games for motivating learning scenario
- the use of artificial intelligence (AI) for data analysis, lesson planning or the design of teaching and learning materials.

1.2 Further Training Courses Offered by Com^{e}Net Chemie

Com^{e}Net Chemistry offers a range of training courses specifically tailored to the needs of modern chemistry teaching and promoting the use of digital media. The courses include

- AI Chatbots in Chemistry Education: Introduction and use of AI-based chatbots to support the learning process.
- Creation of educational videos: Practical training in the production of didactically high-quality educational videos for chemistry teaching.
- Critical Use of Videos in Natural Sciences (“KriViNat”): Didactic concept for the evaluation and reflection of scientific content in videos.
- Video Editing for Chemistry Teaching: Technical and methodological principles for editing and adapting video material.
- Interactive self-learning books: Design of attractive and interactive self-learning resources for chemistry education and its use in the chemistry classroom.
- Digital learning environments: Introduction to tools such as Genial.ly, H5P and Actionbound for creating interactive content.
- AI tools for teaching chemistry: Using artificial intelligence to support lesson planning and data analysis.
- Explanatory videos and analogies for chemical equilibrium: Didactic concepts for teaching complex chemistry topics.
- Teaching chemistry with digital data acquisition systems: Integrating modern measurement technology into practical teaching scenarios.
- Independent development of digital learning environments: Guidance on the independent design and implementation of digital teaching materials such as e-books.

The Com^{e}Net Chemistry training courses include a variety of innovative approaches that promote the use of digital media in chemistry education. As an example, the Actionbound digital learning environment is presented below, focusing on the topic water treatment (SDG 6, 8). This unit allows teachers to explore aspects such as the purity of water, the structure of the water molecule and the substances dissolved in water, while also focusing on one of the project's key cross-cutting themes, Education for Sustainable Development.

2. The Actionbound Application

Actionbound is a media education application that can be used to create and play "Bounds". Actionbound was originally developed as a digital scavenger hunt for leisure activities, but is suitable for making playful learning accessible for educational purposes [2]. It is created using a browser-based editor and used via the accompanying app, which is available free of charge for iOS and Android [3], [4].

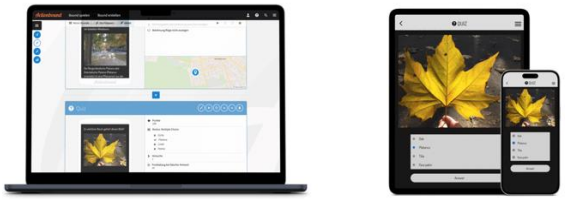

Fig. 1. Editor in the browser & game in the app (Actionbound, 2025)

Bounds are created using the browser-based Bound Creator, which allows intuitive use without programming knowledge [4]. In addition to traditional content such as text, images and video, users can add elements such as quizzes, tasks, QR codes or GPS-based content [6].

Actionbound uses elements of gamification to promote learning through fun and interactivity [2]. This leads to increased motivation, engagement and creativity among participants [4]. Of particular note is the option for students to create their own Bounds, which promotes independence, media literacy and teamwork [3], [4].

An internet-enabled device (smartphone or tablet) is required to use the app, but Bounds can be downloaded in advance so that no internet connection is required during the game. The basic version is free. Additional features and the option of visual design can also be purchased as a licence [2], [3].

The water treatment concept "Aquaville and the secret of Aqua Cristallo" is presented below.

3. Aquaville and the Mystery of Aqua Cristallo

Aquaville is a fictional town known for its crystal clear waters. However, unusual weather phenomena and a deterioration in the quality of the water are threatening the region's ecological balance. At the heart of Aquaville is the mystical Aqua Cristallo spring, which according to legend has the power to stabilise the climate and maintain the purity of the water. However, this spring seems to have lost its power due to human intervention and climate change.
The Aquaville activity is divided into five stations, each dealing with a different aspect of water (e.g. quality, composition). Participants move through these stations, carrying out experiments that teach scientific principles. The playful aspect is emphasised by the narrative and exploratory nature of the tasks.
The story of the mystical spring "Aqua Cristallo" serves as a motivational framework in which participants take on the role of environmentalists and actively participate in saving Aquaville. At each station, they are presented with challenges that they must solve with creativity and teamwork. This increases identification with the task and creates an immersive experience.
In addition, interactive elements such as independent experimentation with different devices and analysis of the results enhance the playful aspect. For example, participants can test their problem-solving skills in a motivating environment by completing matching tasks or using QR codes to guide them to the next stations.

Fig. 2. Screenshots from the Actionbound

The following stations must be completed in Bound:

Station 1: Separation of substances
The objective is to purify a polluted mixture of water, oil, sand, stones, iron powder and salt in order to obtain clean water. Participants will use different separation techniques such as decantation, filtration and evaporation. This enables them to understand the physical and chemical properties of the substances and to separate them according to their specific properties.
Station 2: Properties of water
In this station, the students study the polarity of water. They investigate the deflection of a thin jet of water in an electric field, the surface tension and the solubility of minerals in water. The aim of these experiments is to gain a deeper understanding of the structure of the water molecule.
Station 3: The composition of water
Electrolysis is used to study the composition of water. The products hydrogen and oxygen are tested using the oxyhydrogen test and the glow chip test.
Station 4: Carbon dioxide (CO_2) in water
This station analyses the CO_2 content of various water samples. Tap water, salt water and distilled water are examined at room temperature. The experiments show how much CO_2 can be dissolved in water. The implications for climate and water quality are also discussed.
Station 5: Acid-base reactions
Students investigate the pH of different liquids such as tap water, citric acid and a soap solution. The aim is to understand the importance of pH for water quality and to recognise the differences between acidic, neutral and alkaline solutions.

The Aquaville game ends with a final task in which players use their knowledge to assess the quality of Aquaville's water and suggest ways to improve it.

4. Presentation of the Training Concept

The aim of the training concept is to give participants a practical introduction to the Actionbound digital learning platform and to enable them to integrate the platform into their teaching independently. The training course has a modular structure and consists of an asynchronous preparation part, a face-to-face event and a digital debriefing.
The technical requirements for participation are a stable internet connection, a laptop or tablet and an Actionbound account, which will be provided if needed. The concept focuses on experimental learning and digital education, developing both subject-specific and cross-curricular skills. Particular emphasis is placed on the application of scientific principles, reflection on sustainability issues - especially in relation to SDG 6 (clean water and sanitation) - and the acquisition of digital literacy skills.
In addition, the training emphasises the use of Actionbound as a tool to promote teamwork, problem-solving skills and creative thinking in order to best prepare participants for the challenges of modern education.
The training is structured as follows

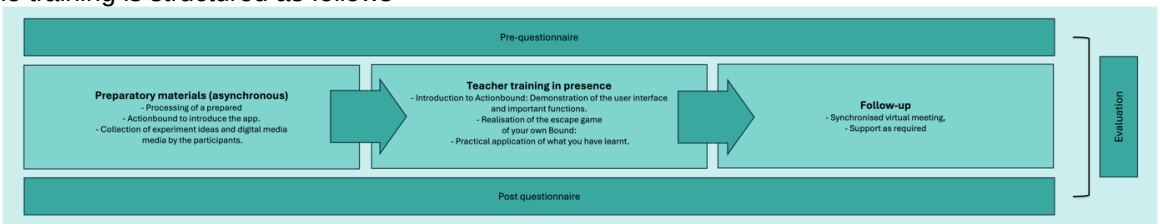

Fig. 3. Course of the training programme

Preparation (asynchronous):
Prior to the face-to-face event, participants receive information material about Actionbound and the possibilities of this tool, which is integrated into a bound. This bound helps them to create and edit digital learning content. Teachers then have the task of collecting experiments and suitable digital materials on a topic of their choice, which they can then use in the practical part.

Face-to-face event:
The training course is divided into several sections that build on each other and ensure direct practical relevance:

- **Introduction to Actionbound:** A short presentation gives an overview of the functions and possible uses of the application.
- **Practical part "Aquaville":** Participants experiment with the interactive content of Actionbound "Aquaville and the secret of Aqua Cristallo". They will use digital sensors and gain insight into the design of the experiments. This phase is used not only to deepen their own knowledge, but also to test methods for activating students.
- **Independent creation:** Under guidance, participants develop their own Bounds by integrating the materials collected in the preparation phase. Special attention is paid to the possibilities of differentiation and to the integration of switch logics ("switches"), which allow an individualised control of the learning process.

Debriefing (digital):
A synchronous digital debriefing takes place two to four weeks after the face-to-face event. Participants present the Bounds they have created, discuss challenges and receive constructive feedback. The aim is to provide long-term support and inspiration for further projects.

5. Summary and Outlook

The Com^{e}Net Chemistry offers teachers practical support in integrating digital tools into chemistry teaching in a meaningful way. With offerings such as the use of Actionbound and the development of interactive learning environments, it creates new opportunities to make scientific topics exciting and tangible. The example of "Aquaville and the mystery of Aqua Cristallo" shows how gamification and experimentation can be combined to engage students in topics such as water quality and sustainability.

“Funded by the European Union - NextGenerationEU and supported by the German Federal Ministry of Education and Research. The views and opinions expressed are solely those of the author and do not necessarily reflect the views of the European Union, European Commission or the Federal Ministry of Education and Research. Neither the European Union, the European Commission nor the Federal Ministry of Education and Research can be held responsible for them.”

SPONSORED BY THE

Federal Ministry of Education and Research

REFERENCES

[1] Ponath, J., Bohrmann-Linde, C., Rubner, I., Sommer, K. & Fechner, S., Digitalisierungsbezogene Kompetenzen (angehender) Chemielehrkräfte, Conference Paper, 50. Jahrestagung der Gesellschaft für Didaktik der Chemie und Physik e.V., Hamburg, 878-881. https://gdcp-ev.de/wp-content/uploads/securepdfs/2024/06/P098_Ponath.pdf
[2] Hesser, R. & Rubner, I., „Actionbound – Ein Digitales Tool Für Den Chemieunterricht“, DiCE-Tagung 2023 – Digitalisation In Chemistry Education. Jena, Friedrich-Schiller-Universität, 2023. https://doi.org/10.22032/dbt.59427
[3] Zwick, S., Lenker, C., Hamer, I., Güzelmeriç, A., Schatz, E., Wiethoff, D., Küpper, F. & Deeg, C., „Die Bibliothek Spielerisch Entdecken Mit Der Lern-App Actionbound“, Bibliothek Forschung Und Praxis, 2016, 50-63. https://doi.org/10.1515/bfp-2016-0005
[4] Krickel, C. & Zwick, S., „Actionbound – EDU-Guide. Ein Wegweiser Zum Pädagogischen Einsatz Von Actionbound“, Actionbound OHG, 2019.
[5] Actionbound, 2025. https://de.actionbound.com

[6] Mielke, A. & Witt, E., „Campusrundgang Mal Anders. Erstellung Von Actionbound-Touren Für Die Orientierungswoche Des Departments Information“, API Magazin, 2020. https://doi.org/10.15460/apimagazin.2020.1.2.39
[7] ComeMINT, Fortbilden Durch Vernetzen, Vernetzen Durch Fortbilden, 2025. https://comemint.uni-due.de