

# Comic4Welfare: An Interactive Comic-Based e-Learning Platform for Animal Welfare Education

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**Abstract:** Traditional methods in agricultural and animal welfare education often fail to convey ethical complexity or engage learners meaningfully. To address this, the project Tierschutz erleben introduces Comic4Welfare - a digital learning platform that combines gamified storytelling, interactive comics, and a unique comic-creation tool, the Comic Automaton, to support engaging and effective learning in animal welfare. By combining factual knowledge with emotionally resonant scenarios, the platform promotes empathy, critical thinking, and learner engagement. It guides users from structured reading modules through decision-based comic tasks to the creation of their own comics, fostering experiential, constructivist learning. Developed through iterative, user-centered design and tested in workshops with students, Comic4Welfare has shown strong potential to enhance usability and educational impact. The Comic Automaton empowers learners to visually narrate and reflect on their understanding, bridging affective and cognitive domains. This approach centers on the concept of “learning through creation,” making complex content more accessible and personally relevant.

**Keywords:** Gamified learning, Storytelling, Interactive comics, Comic creation, Animal welfare education

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## 1. Introduction

The keeping of livestock such as cattle and sheep plays a vital role in ensuring food security and maintaining cultural landscapes. At the same time, livestock farming has become the subject of increasing public scrutiny, often marked by emotionally charged debates and a declining appreciation for animal agriculture (Boehm et al., 2010). In light of these developments, improving animal welfare has become a key ethical and legal priority (Spiller et al., 2015). Meeting this responsibility requires well-trained farmers, educators, and veterinary professionals who possess current and practice-relevant knowledge of animal needs, species-specific husbandry systems, and early indicators of illness or distress.

However, a persistent gap between scientific findings and their practical implementation on farms has repeatedly been pointed out (Jansen et al., 2009; Merle et al., 2024; Shiels et al., 2021). In many cases, established findings fail to reach the people who make day-to-day decisions in animal husbandry, or they are not sufficiently integrated into educational settings. This disconnect is further reinforced by outdated teaching approaches, which often focus on lecture-based instruction rather than active learning. Yet, modern learning theory emphasizes that sustainable learning outcomes are best achieved when learners are encouraged to take ownership of the learning process and engage with the material in self-directed, situated, and socially meaningful ways (Ragland et al., 2023).

One key challenge in animal welfare education lies in conveying the consequences of inadequate decision-making in a comprehensible and pedagogically effective way. Such consequences cannot be demonstrated realistically or ethically in practical training environments. Digital media and interactive simulations provide a promising alternative, particularly for younger learners and students in agricultural education. They help make complex systems accessible and enable learners to explore the outcomes of their actions without exposing real animals to harm (Veenema et al., 2024). This paper presents a novel digital approach to address these challenges by combining interactive storytelling with simulation-based learning. Building on interdisciplinary collaboration between animal scientists, media designers, educators, and developers, we have developed an educational platform (*Comic4Welfare*) that integrates narrative learning and user participation. In this context, we introduce the concept of an integrated comic creation tool (Comic Automaton), which serves as an authoring environment enabling learners to engage with animal welfare issues creatively and reflectively.

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This paper presents the development process of the *Comic4Welfare* platform, focusing on the conceptual, technical, and design decisions involved in creating its interactive comics and comic creation tool. It outlines how pedagogical principles were translated into digital formats and how interdisciplinary collaboration shaped the implementation of narrative-based learning components in the context of animal welfare education.

## **2. Theoretical Framework and Pedagogical Approach**

To ground the development of *Comic4Welfare* in established educational principles, the following section outlines the theoretical framework and pedagogical approach that informed its design. Our analysis of the animal welfare education landscape revealed the need for a more engaging, accessible, and learner-friendly methodology — one that moves beyond the limitations of conventional, text-heavy materials. Traditional textbooks often fail to capture the practical and emotional dimensions essential in this field.

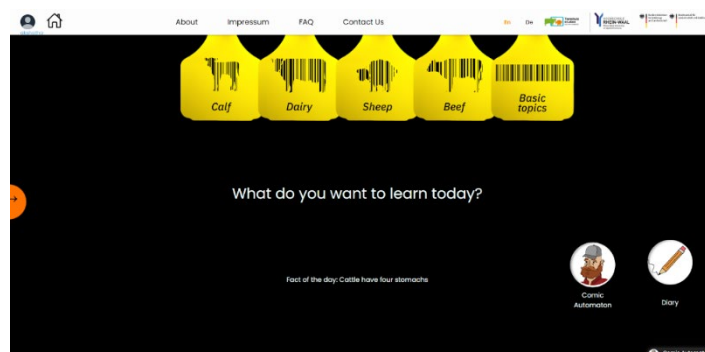
In response to the limitations of conventional materials, we adopted a design approach grounded in constructivist learning theory, which emphasizes active engagement, self-directed learning, and contextualized meaning-making. *Comic4Welfare* integrates narrative elements, role-playing, and decision-making with factual content and is intended to create immersive and experience-oriented learning environments. This learner-centered strategy may support personal meaning-making and enhance knowledge transfer through active participation. A key platform feature is the Comic Automaton, which enables learners to create their own stories and explore individual perspectives on animal welfare practices. This process is expected to foster deeper engagement and may support cognitive strategies such as active recall, potentially strengthening memory and comprehension through creative expression. Learner-generated comics can also be shared and discussed with peers, which might promote the exchange of diverse viewpoints and collaborative reflection.

The use of comics may further encourage emotional and empathetic responses, for example by portraying animals in vulnerable situations through expressive visuals. This approach is conceptually aligned with socio-emotional learning principles, which emphasize compassion, ethical awareness, and reflective thinking as relevant components of animal welfare education. As Goodbrey (2015) points out, interactive or "game" comics represent an emerging narrative medium with underdeveloped design frameworks and theoretical foundations. These limitations become particularly evident when attempting to implement branching narratives in educational contexts. Neo and Mitchell (2016) similarly describe a conceptual tension between interactivity and narrative coherence, which can hinder the effectiveness of learning experiences.

Considering these challenges, we opted against the use of a drama management system. Instead, we implemented a simplified "string of pearls" structure, which maintains authorial control while allowing for limited narrative flexibility. This design is intended to balance learner agency with a clear and coherent storyline, thereby offering a potentially engaging and pedagogically sound alternative to traditional self-directed learning tasks. It may also lower the threshold for content creation, both for educators and learners.

## **3. Platform Overview and Learning Environment**

*Tierschutz erLeben* (Welfare Xperience) is a modular digital learning platform that provides foundational knowledge on animal welfare through a blend of illustrated instructional texts, short videos, and interactive media elements. The platform is structured around a central landing page that serves as the entry point to all key features, including basic learning modules, the Comic Automaton, and a personal Learning Diary (Figure 1). These components are designed to support different learning styles and levels of prior knowledge. While the platform offers a broader theoretical framework and complementary materials beyond comic-based learning, this paper focuses specifically on its two core interactive elements: the decision-based interactive comics and the Comic Automaton (*Comic4Welfare*). In addition to these content-based features, the platform incorporates tools to support reflection and self-regulated learning.

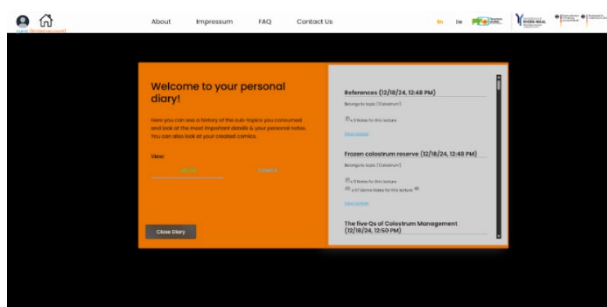


**Figure 1: Screenshot of the landing page that greets every user. The main features - the Comic automaton, the basic study modules and the learning diary are clearly defined**

#### 4. Learning Support and Feedback Tools

To foster self-regulated learning, the platform includes a *Learning Diary* where users can document their progress, take notes, and plan future learning activities. Learners are invited to add manual or automatically generated reflections after each exercise, whether based on comics or theoretical content. This diary is organized chronologically according to the learner's journey and serves as a repository for completed comics and a planning tool to support self-regulated learning (Figure 2).

These pedagogical features are supported by a robust technical foundation that enables seamless integration of interactive and reflective elements across the platform.



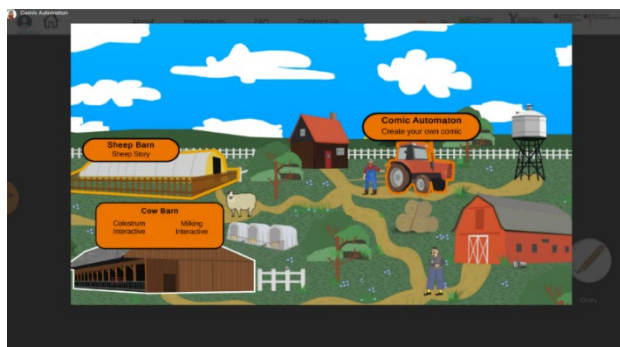
**Figure 2: Screenshot of the Comic Automaton, showcasing all the interactive features of the learning platform in one accessible hub**

#### 5. System Architecture and Implementation

The learning platform is a full-stack educational web application that supports a multimodal blend of text, images, videos, and interactive content, including interactive comics and a comic creation tool. Its system architecture follows a modular client-server model. The front end was implemented using Angular and Ionic, with WebGL employed to render interactive elements and Apollo Client facilitating communication with the back end via GraphQL. Unity (version 2021) was selected to develop both the Comic Automaton and the interactive comics, based on the development team's expertise and Unity's flexibility in accommodating evolving creative concepts during the innovation process. Figma prototypes were created and iteratively refined to guide and streamline the design phase. This technical foundation enables the implementation of the platform's key interactive elements, particularly the interactive comics and the Comic Automaton, which are described in the following section.

#### 6. Interactive Comics and Comic Creation (Comic4Welfare)

At the heart of the platform are the decision-based, interactive comics and the Comic Automaton (*Comic4Welfare*), which serve as the primary focus of this paper (Figure 3). The interactive comics present decision-based scenarios in which users actively apply their knowledge and experience the consequences of their choices in a safe, simulated environment. These narrative sequences are embedded in thematic modules and can be repeated with different outcomes, encouraging exploration and critical thinking.



**Figure 3: Screenshot of the learning diary. The diary acts as a collection of notes entered automatically from interactive comics and manually by the user**

In a subsequent phase, learners use the Comic Automaton to create their own comics, drawing on characters, scenes, and events introduced in earlier stages. This creative process supports reflective learning, emotional engagement, and value-based reasoning. It also allows learners to reframe and express their understanding of animal welfare topics through personal storytelling. Optional sharing features encourage peer feedback and dialogue, supporting collaborative reflection and exposure to diverse viewpoints.

## 7. Interactive Comics

*Comic4Welfare* includes three comics aligned with core learning modules: Colostrum and Milking, both interactive, and a linear sheep-focused comic designed to explore more emotionally driven storytelling and narrative structure. The interactive comics exemplify the principle of learning through decision-making and acting, where users encounter branching points that illustrate the consequences of their choices in subsequent panels. Due to the constraints of a research-driven development process, the branching structures are intentionally limited to a few key decision points or simple equivalent tasks. All narrative paths ultimately converge back to the main storyline. Typically, one path represents an optimal outcome, while alternative paths reveal the potential negative consequences of poor decisions. Animals like cows and sheep are featured as central characters, with expressive visual cues to enhance emotional resonance. Their interactions with human figures—farmers, veterinarians, and trainees—serve to guide learners through complex processes related to animal welfare (Figure 4). These comics are designed as dialogic experiences, interspersed with instructional slides, and delivered through interactive speech bubbles that simulate a guided conversation between the learner and the system.



**Figure 4: Screenshot of a slide where a friendly character guides the user through making choices to move the comic forward**

For instance, the Colostrum comic follows the decision-making process surrounding administering first milk to newborn calves. Alongside storytelling elements, the comic provides factual information on the tools, techniques, and timing required for effective care (Figures 5 and 6). The correct path in the narrative results in healthy calves, while poor decisions, such as neglecting hygiene or mismanaging storage time, alerts the user of the adverse outcomes.

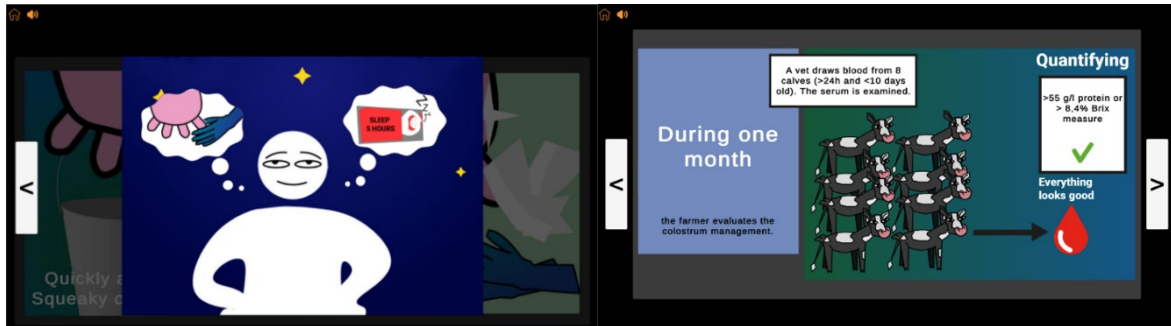


Figure 5: (Left) Screenshot of the screen where the user realizes the impact of their hygiene-related choice, shown through a clear and engaging visual outcome. (right) Screenshot of the screen where the user gains knowledge by encountering various facts shared throughout the comic journey

## 8. Comic Automaton

The *Comic Automaton* is designed as a creative editor for constructing linear comics, granting learners significant agency to visualize and articulate their understanding of animal welfare. The automaton welcomes users and introduces key features on the initial screen (Figure 6). Users begin by adding empty panels that serve as a canvas for story development. The tool offers a rich asset library that includes characters frequently encountered in prior modules, such as farmers, veterinarians, and trainees, as well as imaginative additions like an alien or a rubber duck, intended to foster creativity and engagement. The asset pool also includes objects ranging from brix scales (a tool to measure colostrum quality) to fences and animals depicted with varied emotional expressions, broadening the tool's applicability across diverse learning scenarios.

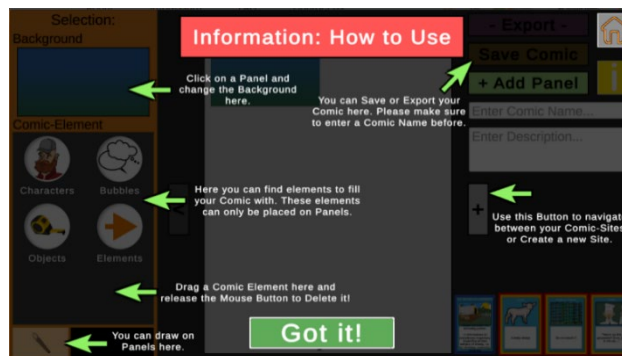
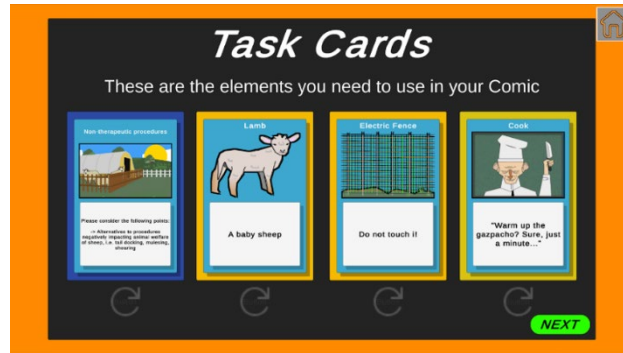


Figure 6: Screenshot of the initial screen displaying basic guidelines, where the comic automaton introduces itself and explains the different features available to the user

While many learners welcomed the creative freedom, some found it challenging to generate narratives independently and maintain alignment with learning objectives. To support such users, the *Comic Automaton* includes two modes of use: a **Free Mode**, allowing unrestricted storytelling; and a **Task Mode**, which provides narrative scaffolding via a set of four randomly drawn “task cards” (Figure 7). Each card represents one of four categories: a learning goal, a main character, a tool, and an out-of-context element. Inspired by the metaphor of a deck of cards, this structure stimulates imaginative storytelling while keeping the narrative anchored in educational objectives. Completed comics can be saved, retrieved, and exported as PDF files, enabling learners to present their work in classroom settings, share with peers, or use as a personal record of learning progress. An example of a comic created shows the usage of various components of the comic automaton (Figure 8). This combination of creative freedom and structured guidance makes the *Comic Automaton* a powerful tool for reflective and expressive learning.



**Figure 7: Screenshot of the task cards mode, which prompts a combination of four play cards that acts as a foundation for the student's narrative**



**Figure 8: Screenshot of a comic sequence generated using the comic automaton, illustrating the story of a perceptive farmer who consults a veterinarian in a timely manner to ensure his calf's well-being**

## 9. Usability

*Comic4Welfare* offers a simplified user journey by placing its core features, the *Comic Automaton* and interactive comics within a single hub, the Playground. After each topic, learners can return to this space to actively apply knowledge through creative and interactive exercises. The platform's visual design prioritizes clarity and accessibility, combining dark mode to reduce eye strain with lighter reading screens that enhance legibility, all within a consistent comic-inspired design language. Development was shaped through iterative user testing and participatory workshops, ensuring usability remained central. To close the feedback loop, a learning diary tracks user progress and supports continuous reflection. Meanwhile, the flexible backend empowers educators to adapt content, enabling the platform to serve a wide range of pedagogical needs and educational contexts.

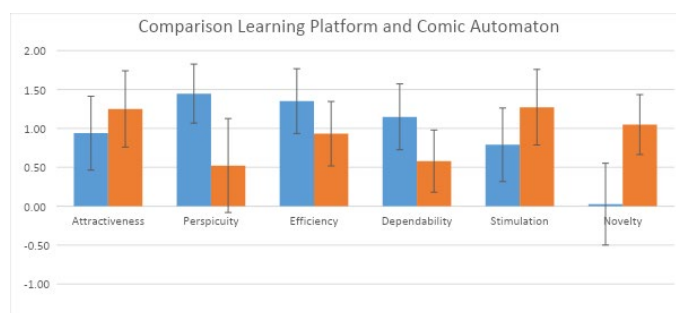
## 10. User Testing and Workshops

Over the course of the project, four workshops and user testing sessions were conducted involving a range of 10-20 participants in-person for each of the sessions. The participants were students of agriculture and animal husbandry at the university between second to fourth semesters, guided by a human-centered design approach. These sessions played a pivotal role in shaping the platform, offering valuable insights that directly influenced decisions related to style, functionality, and user engagement strategies.

The first workshop introduced students to the platform concept, focusing on topics such as cattle and sheep. As early adopters, they engaged in brainstorming sessions with preliminary mock-ups, including paper prototypes of 3D simulations and learning strategies. The goal was to gather impressions, emotional responses, and expectations, with feedback emphasizing how learners acquire knowledge and what resources they use. A key insight was the need for immersive, visually engaging tools. This guided development toward narrative storytelling and 2D comic-based learning, which proved more effective for motivation and clarity, while 3D simulations were seen as time-intensive, less visually clear, and offering limited active participation.

The second workshop applied the dot-voting method on paper prototypes to evaluate features such as the comic storyline, button layouts, and linear storytelling format. This exercise helped identify the most desirable elements and tested whether users could intuitively navigate the interactive flow. The session marked a shift from exploratory, qualitative feedback toward more data-driven evaluation of design decisions.

The third workshop tested early versions of the Comic Automaton, envisioned as a creative playground for learners. Combining A/B testing with UEQ surveys, it assessed factors such as clarity, attractiveness, and efficiency, while also observing how students approached story creation (Figure 9). The results showed enthusiasm but also difficulties in generating narratives and staying focused on learning goals. These findings led to the development of a task mode, offering structured guidance to better support comic creation and align with educational objectives.



**Figure 9: The comparison results from UEQ across 6 measured dimensions shows the learning platform as clearer, more efficient, and reliable, while the Comic Automaton is seen as more attractive, stimulating, and novel feature but less effective**

The fourth workshop evaluated the usability and effectiveness of the nearly complete platform, focusing on the Comic Automaton, interactive comics, and their integration with the learning diary. Using a think-aloud protocol, participants provided real-time insights into the interface's intuitiveness, uncovering several usability challenges and technical pain points that informed final refinements. The session concluded with a brief interactive exercise using post-it notes, which captured quick feedback. The responses were positive, affirming the design choices and highlighting the platform's potential to engage learners effectively. Together, the workshops ensured that user needs remained central throughout development.

## 11. Reflection and Conclusion

At its inception, the *Comic4Welfare* Platform was conceived in response to a growing need for innovative, user-centered pedagogical approaches in agricultural education (Boehm et al., 2010; McGrath et al., 2024). Traditional methods often struggle to engage learners with the ethical complexity and emotional dimensions of animal husbandry. The project was therefore designed to integrate established pedagogical strategies, such as narrative framing, visual communication, and the didactic potential of comics, with the principle of learning by doing, to address the challenge of creating immersive and engaging educational experiences appropriate to the domain of animal husbandry. This approach aims to foster not only knowledge acquisition but also critical thinking, empathy, and reflective decision-making within playful, but realistic scenarios. The current version of *Comic4Welfare* is designed to guide learners through interactive, branching storylines and ultimately enable them to create their own comics. This fosters a dual learning role as both recipient and creator of knowledge, an approach grounded in participatory culture and learner agency (Jenkins et al., 2015). While the present narrative structure relies on largely predefined story paths and simplified interaction logic, the platform's underlying architecture is intentionally modular and scalable, laying the groundwork for future expansion and technical sophistication. Unity was selected as the development environment due to its robust multimedia capabilities and flexibility in rapid prototyping. This choice aligned with available development expertise and the ambition to create a visually rich user experience. In retrospect, however, frameworks dedicated to 2D interactive storytelling, such as Ink or Twine, might have proven more efficient for handling complex branching logic and deploying lightweight, text-driven applications (Letonsaari, 2019).

Artificial intelligence (AI) is not yet integrated but is envisioned as a key element in future development. Its implementation could help experts generate content more efficiently and expand the Comic Automaton's capacity for adaptive, user-driven narratives - for example, by dynamically adjusting storylines based on learner choices or providing intelligent feedback during comic creation. At present, narrative progression is limited by technical and design constraints, leaving the potential of fully emergent, non-linear storytelling untapped.

However, the system's open architecture and authoring model are designed to support such enhancements, aligning with the project's vision of fostering individualized, engaging, and pedagogically grounded learning experiences.

*Comic4Welfare* is being continuously tested with 2nd–4th semester students in agricultural and animal welfare programs. In one practical, 22 students created comics as an assignment and rated usability, engagement, and continued use of the Comic Automaton at 3 out of 5. Feedback highlighted the value of visual storytelling for addressing complex ethical issues. Ongoing surveys with added study material aim to further evaluate the platform's continued relevance and design effectiveness. However, the long-term educational effects remain to be systematically evaluated. Continuing future research along the lines of meaningful gamification, as demonstrated in our project and informed by Massler et al. (2022), will require assessing learning outcomes, user retention, and transferability to other subject areas. Moreover, the scalability of the platform and its adaptability to diverse user groups, ranging from vocational trainees to university students and even practitioners, will be critical factors for its sustainable implementation. *Comic4Welfare* thus represents a promising, but still evolving, approach to transforming agricultural education through creative digital pedagogy.

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**Ethics Declaration:** The authors declare that this work is original and has not been published elsewhere. All sources and references have been appropriately acknowledged. No part of this paper involves plagiarism, data fabrication, or unethical research practices. Where applicable, all necessary ethical approvals have been obtained, and there are no conflicts of interest to declare.

We have no conflict of interest to declare. Correspondence concerning this article should be addressed to Steffi Wiedemann, [Steffi.wiedemann@hochschule-rhein-waal.de](mailto:Steffi.wiedemann@hochschule-rhein-waal.de)

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