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"Chemyzone": An Innovative E-Magazine for Chemistry and Chemical Literacy Education on Addictive Substances to Support Sustainable Development Goals (SDGs) Completed with Bibliometric Analysis

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ABSTRACT

Chemical literacy plays a vital role in enabling students to understand chemical concepts and their relevance to everyday life, particularly in addressing social challenges such as substance abuse. In Indonesia, the increasing prevalence of narcotics and psychotropic abuse among adolescents, coupled with limited engaging learning resources and a low national science literacy score, underscores the urgency for innovative educational media. This study introduces Chemyzone, a digital e-magazine designed to enhance chemical literacy on addictive substances. The study focused on the development phase to produce a visually engaging and accessible learning tool. We also added a bibliometric analysis to support this study. The resulting e-magazine integrates knowledge, context, competence, and attitude dimensions of chemical literacy, offering support for classroom instruction while extending its reach to the broader public. The findings suggest that Chemyzone has the potential to raise awareness and improve understanding of addictive substances through technology-based education. This study adds new information regarding sustainable development goals (SDGs).

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1. INTRODUCTION

Chemical literacy is a crucial aspect of science education, as it enables students to understand chemical concepts and apply them to real-life situations (Faisal *et al*., 2023). Chemical literacy is needed to address social issues such as substance abuse, which continues to be a challenge for society (Singh *et al*., 2025). According to Shwartz, equipping students with the ability to connect scientific knowledge to everyday life will foster awareness and responsible decision-making (Shwartz *et al*., 2006), starting even in the smallest details.

According to the Badan Narkotika Nasional of Indonesia, drug and psychotropic abuse among adolescents is increasing and has become a serious public health problem (see https://bnn.go.id/hani-2024-masyarakat-bergerak-bersama-melawan-narkoba-mewujudkan-indonesia-bersinar/), the World Drug Report in 2021 further notes that more than 300 million people worldwide have used illicit drugs classified as addictive substances, which are generally divided into narcotics, psychotropics, and other addictive compounds (see https://hpu.ugm.ac.id/2020/05/07/napza-zat-candu-yang-berbahaya/). Excessive and unsupervised use of these substances negatively impacts various aspects of life, including education, where it disrupts learning and lowers academic achievement (Blevins & Khanna, 2016). At the same time, learning resources that can effectively explain the dangers of addictive substances from a chemical perspective are still limited. As a result, many students fail to critically connect what they learn in class with the realities they face in society (Majid & Rohaeti, 2018; Masaguni *et al*., 2023).

This lack of connection between knowledge and context is also reflected in Indonesia's performance in the Programme for International Student Assessment (PISA), where the national average score in science remains far below the OECD standard (see https://doi.org/10.1007/978-94-6209-497-0_69). These results indicate that students face difficulties in applying scientific understanding to authentic, everyday contexts. Therefore, strengthening chemical literacy is not only an educational need but also a national priority.

This problem is exacerbated by the low reading interest observed among Indonesian students and the wider community (Wiranatha & Santosa, 2024). Traditional, text-heavy learning materials are often perceived as monotonous, making them less engaging for students. This cultural tendency toward limited reading habits creates additional barriers to developing scientific literacy through conventional media.

Digital technology offers a potential breakthrough to address this challenge by presenting knowledge in more interactive and visually engaging formats (Rasyid *et al*., 2024). Rather than relying solely on text, technology-based media can incorporate images, videos, and dynamic designs to transform the way students interact with information (Bunari *et al*., 2024). In this regard, technology is not just a supporting tool but also an agent of change that can reshape reading habits and make learning more engaging and accessible (Spjeldnæs & Karlsen, 2024).

To address this challenge, Chemyzone was developed as a digital e-magazine that integrates scientific content with an attractive design. The structure of Chemyzone is grounded in chemical literacy dimensions encompassing content knowledge, contextual understanding, scientific competence, and attitudes toward chemistry, which are essential for preparing students to engage with chemistry-related socioscientific issues. The magazine presents news, history, experiments, and practical tips directly related to the issue of addictive substances. The novelty of this study is to describe the development process of Chemyzone using the ADDIE model during the development stage, while also demonstrating its potential as an innovative medium for strengthening chemical literacy and raising

awareness of pressing social issues. We also added a bibliometric analysis to support this study. This study adds new information regarding sustainable development goals (SDGs).

2. METHODS

This study employed a Research and Development (R&D) approach to design and validate a digital learning medium in the form of an e-magazine. The development process followed the ADDIE model and was limited to the analysis, design, and development phases due to contextual constraints, while the implementation and evaluation phases are recommended for future research (Faisal *et al*., 2023; Adawiyah *et al*., 2025).

This scope was chosen to maximize the creation of a functional prototype of the e-magazine, while the implementation stage was restricted to feasibility testing involving a small group of respondents rather than a large-scale classroom application.

At the analysis stage, a needs assessment was conducted with 20 respondents aged 17–26 years (Widarti *et al*., 2022), chosen based on data from Badan Pusat Statistik Indonesia, which indicates that this age group represents the highest proportion of mobile phone users (see https://www.bps.go.id/id/statistics-table/2/MTIyMiMy/proporsi-individu-yang-menguasai-memiliki-telepon-genggam-menurut-kelompok-umur.html) and therefore the most relevant target for digital learning innovation. The analysis further included concept mapping and discourse analysis to structure the thematic framework of the e-magazine, which was then refined into six sections: Chemy News, Chemy Tips, Chemy Islamic, Chemy Fact, Chemy History, and Chemy Lab.

The design stage involved preparing a storyboard to visualize the content structure and navigation flow. This storyboard then served as a blueprint for drafting the e-magazine design using Canva. After the design was finalized, the file was exported into PDF format and subsequently converted into an interactive flipbook using Flip PDF software. The final product was displayed as a digital e-magazine accessible on mobile devices and computers. The entire development process is illustrated in **Figure 1**, which shows the workflow from storyboard design to the final e-magazine display.

Figure 1. The e-magazine development flow from storyboard design to publication in flipbook format

Figure 1 highlights the systematic integration of visual planning, digital design, and interactive publishing tools. By employing Canva for layout design and Flip PDF for interactivity, the e-magazine not only ensures visual appeal but also enhances accessibility and engagement. Such an approach provides a novel model for developing digital learning media in chemistry literacy.

Data were analyzed through both quantitative and qualitative approaches. Quantitative analysis used descriptive statistics, namely mean scores (Likert scale) for expert validation (Jariati & Yenti, 2020) and percentages (Guttman scale) for feasibility testing (Pranatawijaya *et al*., 2019). Qualitative analysis focused on expert feedback and respondents' comments for product refinement. Ethical considerations were observed by ensuring the confidentiality and anonymity of all participants. The novelty of this research lies in the integration of chemical

literacy with an interactive digital magazine (Canva–Flipbook format) on the theme of addictive and psychotropic substances, which has not been previously explored in similar studies.

3. RESULTS AND DISCUSSION

The bibliometric analysis regarding chemical education is presented in **Figure 2**. This method is effective in understanding current research trends, as reported elsewhere (Ibrahim *et al*., 2024; Rahmiyanti, 2024; Abidin *et al*., 2025; Arifiani *et al*., 2025; Lestari, 2024; Nordin, 2022; Bilad, 2022). This figure presents the annual distribution of publications indexed in Scopus related to chemical education, retrieved using the TITLE–ABS–KEY search query "chemical AND education." The data were collected on 6 January 2026, yielding a total of 25,405 documents spanning the period from 1843 to 2026. The results indicate a very limited number of publications before the mid-20th century, followed by a gradual increase beginning in the 1970s. A sharp and sustained growth is evident from the early 2000s onward, reflecting the increasing scholarly attention to chemical education as a distinct research field. The most pronounced rise occurs after 2010, with annual publications exceeding 1,000 documents in recent years. This trend highlights the growing importance of chemical education research in response to global demands for scientific literacy, curriculum innovation, and pedagogical reform. The lower number of documents recorded for 2026 should be interpreted with caution, as the year is incomplete at the time of data collection. Overall, the publication trend demonstrates a strong and continuing expansion of chemical education research in the international academic community.

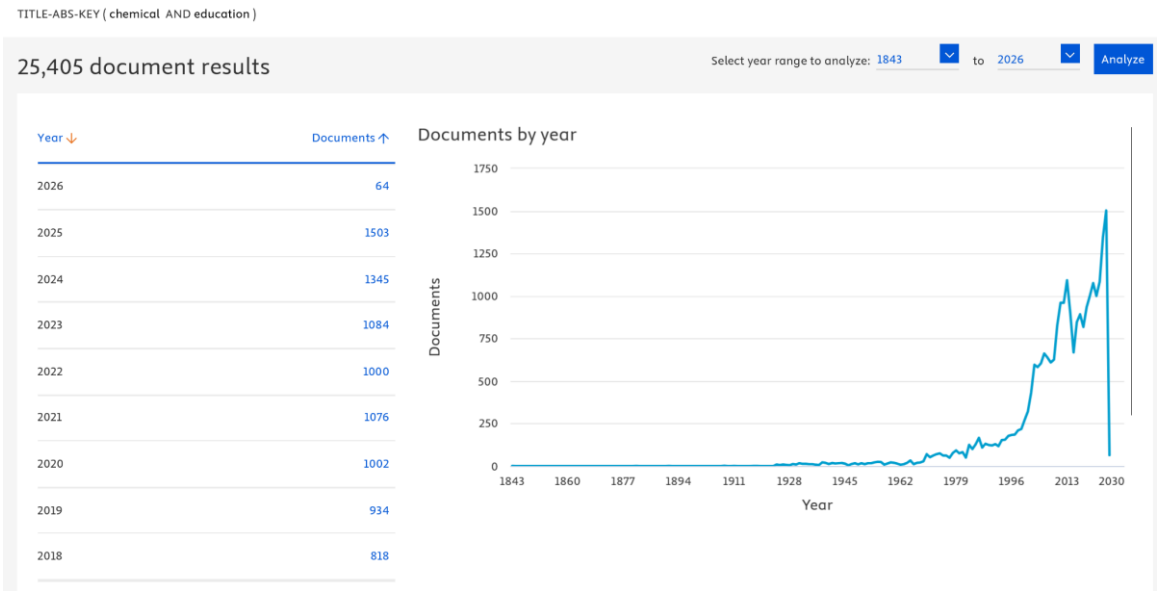

Figure 2. Annual publication trends using the bibliometric analysis in *chemical education* research indexed in Scopus based on the TITLE–ABS–KEY search query "chemical AND education" from 1843 to 2026 (data retrieved on 6 January 2026).

The Chemyzone e-magazine is organized into six thematic sections designed to align with the four aspects of chemical literacy: knowledge, context, competence, and attitude. Each section has a specific role in facilitating meaningful learning about addictive substances (Sjöström *et al*., 2024).

Figure 3(a) provides coverage of regulatory frameworks and societal cases related to addictive substances. This feature serves as an informational medium through which readers can observe governmental and community responses to issues concerning addictive substances, thereby fostering a more comprehensive understanding of the prevailing social context and regulatory environment. In addition, the column functions as a continuous knowledge resource that keeps readers updated on emerging issues while reinforcing awareness of the urgency of controlling addictive substances.

Figure 3(b) examines Islamic perspectives on addictive substances by integrating scientific knowledge with religious values. The topic holds particular significance given that a majority of students in Indonesia adhere to Islam; thus, linking scientific issues with religious principles provides an ethical framework and strengthens the moral rationale for avoiding addictive substances. Moreover, it offers readers a way to approach the issue from a faith-based perspective, thereby reinforcing both its relevance and urgency.

Figure 3(c) features simple experiments delivered through video demonstrations, showcasing laboratory procedures related to the derivatives of addictive substances that can be practiced by readers either at home or in school settings under appropriate supervision. The "Chemy Lab" aims to illustrate that derivatives of addictive substances are not solely associated with negative impacts but can also be applied constructively across various fields.

Figure 3(d) presents fundamental information and scientific facts regarding addictive substances, including narcotics, psychotropics, and other related compounds, as well as their physiological effects on the human body. The material is conveyed both in textual form and through visual representations. Such information is crucial for raising readers' awareness of the dangers associated with substance abuse and serves to equip them with essential foundational knowledge, which in turn provides a basis for engaging with more advanced content presented in Chemyzone.

Figure 3(e) reviews the history of the discovery and use of addictive substances from the past to the present. Such information provides a historical understanding of how the consumption of certain substances has evolved and how it has affected societies over time. By offering this historical perspective, the rubric equips students with insights into the long-term consequences and societal impacts of substance use, thereby fostering deeper awareness of the risks associated with addictive behavior.

Figure 3(f) delivers practical guidance for preventing the use of addictive substances, including strategies to enhance self-awareness, manage stress effectively, and cultivate supportive social environments. Beyond offering lifestyle advice, the rubric plays a crucial role in public health education by equipping readers with preventive measures that are both accessible and applicable in everyday life. In doing so, it strengthens individual resilience while contributing to broader efforts in health promotion and substance-use prevention.

The final product developed in this study is an e-magazine entitled Chemyzone, which consists of 53 pages organized into six rubrics: Chemy News, Chemy Islamic, Chemy Lab, Chemy Facts, Chemy History, and Chemy Tips. Additional features such as a glossary, games, references, and an author profile were included to enhance usability and completeness. The magazine was designed in a digital format with interactive elements such as images (Mutammimah & Udaibah, 2022), animations, videos (Haripottawekul *et al*., 2025; Martiana *et al*., 2025), and hyperlinks to ensure engagement while supporting the development of chemical literacy.

The validity test using the Guttman Scale (Martiana *et al*., 2025; Rizki *et al*., 2016) involved three experts, consisting of two subject matter experts and one media expert, who evaluated each page based on chemical literacy, language, and visual design. The mean validation scores were 3.40 for chemical literacy, 3.42 for language, and 3.38 for design, all of which were interpreted as valid, as shown in **Table 1**. Suggestions provided by validators, such as improving the color palette, adjusting font readability, and adding supporting media (Najuah *et al*., 2023), were incorporated into the revision process to enhance the overall quality of the e-magazine.

(a) (b) (c)

(d) (e) (f)

Figure 3. Page preview of six thematic sections: (a) Chemy News; (b) Chemy Islamic; (c) Chemy Lab; (d) Chemy Fact; (e) Chemy History; and (f) Chemy Tips.

Table 1. Validity Test Recap.

Aspect	Mean	Interpretation
Chemistry Literacy	3.40	Valid
Language	3.42	Valid
Appereance	3.38	Valid
Total	**3.40**	**Valid**

A feasibility test was then conducted with 20 respondents aged 17 to 26 years, representing the target audience most vulnerable to addictive substance issues and active digital media users. The results indicated very high feasibility across four aspects: 98.89% for content, 97.50% for language, 95.00% for design, and 100% for usability, as shown in **Table 2**. These findings confirm that Chemyzone is both accessible and appealing to learners, providing strong evidence of its potential as a learning medium.

The integration of chemical literacy aspects, which include knowledge, context, competence, and attitude, is a key strength of Chemyzone. Each rubric contributes to these dimensions with factual information, socio-regulatory news, laboratory activities, historical perspectives, Islamic values, and preventive tips. This multidimensional approach distinguishes the e-magazine from traditional resources that often emphasize factual knowledge only, thereby aligning with calls for more contextualized and socially relevant science education.

Overall, the findings demonstrate that Chemyzone effectively bridges scientific concepts and real-world issues, particularly the dangers of addictive substances. The positive reception from both experts and users suggests that digital magazines can serve as innovative learning media that respond to students' needs and media habits. This study is limited to a small sample size and to the development phase of the ADDIE model. Future studies should expand testing across diverse educational contexts and measure its direct impact on improving chemical literacy competencies. This study adds new information regarding sustainable development goals (SDGs).

Table 2. Validity Test Recap.

Aspect	Percentage	Interpretation
Material	99.89%	Highly Feasible
Language	97.50%	Highly Feasible
Appearance	95.00%	Highly Feasible
Easiness	100.00%	Highly Feasible
Total	**97.85%**	Highly Feasible

4. CONCLUSION

This study developed and validated an innovative e-magazine entitled Chemyzone to improve chemical literacy on addictive substances. This study was also completed with a bibliometric analysis. Using the R&D method with the ADDIE model limited to analysis, design, and development stages, the research produced a functional prototype validated by experts and tested for feasibility with respondents aged 17–26 years. The results showed that Chemyzone is both valid and highly feasible as a digital learning medium, integrating six rubrics: Chemy News, Chemy Tips, Chemy Islamic, Chemy Fact, Chemy History, and Chemy Lab, aligned with four dimensions of chemical literacy. As the first interactive e-magazine on addictive substances, Chemyzone offers an engaging and accessible medium that supports

students, teachers, and society in critically connecting scientific concepts with real-life contexts.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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