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Creation of A Colloid E-Magazine Oriented Towards Chemical Literacy

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ABSTRACT
This research aims to describe the appearance, validation test results, and feasibility test results of an e-magazine oriented toward chemical literacy on colloidal materials. This media is expected to enhance students' literacy in colloidal materials. The research method used is Design-Based Research (DBR) with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The study consists of two main stages: the product development stage, which includes analysis and design, and the product testing stage, which includes validation and feasibility tests. The resulting product is an e-magazine designed to promote chemical literacy on colloidal materials. The validation test was conducted by three experts—lecturers and teachers specializing in materials and media. The average r-calculated values for material, language, and media display aspects were 0.93, 0.97, and 0.98, respectively, indicating that the e-magazine is valid. Subsequently, the product underwent a feasibility test with 15 students who had previously studied colloidal materials. The average feasibility test scores for material, language, and media appearance were 93%, 82%, and 95%, respectively. Based on these results, the e-magazine is deemed suitable as a learning medium.

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Introduction

The advancement of technology in the era of globalization has significantly contributed to global education, particularly in developing tools that enhance teaching and learning. One such tool is the e-magazine, a digital learning medium that serves as an innovative alternative to traditional printed materials. E-magazines represent a breakthrough in utilizing technology to improve the quality of education worldwide (Nurlina et al., 2018).

Educational media play a crucial role in assisting both educators and students in achieving learning objectives. This is because media can influence emotions, thoughts, desires, and attention in an educational setting (Selfiani, 2018). Traditionally, learning media used in classrooms include worksheets (LK), printed books, or modules. However, these materials often lack visual appeal, which can reduce students' interest in reading. To address this issue, using a chemistry magazine as a learning tool could be more effective, as it presents information in a visually engaging format (Asfuriyah & Nuswowati, 2015).

Chemistry magazines have evolved as both a learning resource and an instructional medium. Innovative and creatively designed learning media can significantly enhance students' motivation to learn (Muhdiani, 2019). In this study, learning media in the form of scientific magazines were developed. The findings suggest that well-designed e-magazines, which integrate text, images, audio, videos, and animations, can increase students' motivation by providing a more engaging and interactive learning experience. Additionally, the online nature of e-magazines reduces excessive paper usage, thus helping to mitigate the impact of global warming (Arista, 2020).

One of the key challenges in teaching chemistry, particularly colloidal materials, is the lack of engaging learning media that can stimulate students' motivation and enthusiasm. Traditionally, students learn by reading material, listening to teacher explanations, and answering exercises, which can make the learning process monotonous and unengaging. However, student motivation is essential for effective learning, as it fosters enthusiasm and enhances understanding. A suitable solution to this issue is the use of multimedia-based learning media, such as e-magazines, which can enhance students' interest, engagement, and overall learning experience (Arsyad, 2017).

Many natural phenomena can be explained through chemistry, but the subject is often perceived as difficult due to its abstract nature. To address this, the use of e-magazines as learning media can help students connect chemistry concepts to real-life applications. According to Darmawan et al. (2020), interactive multimedia learning—which integrates text, images, videos, audio, and animations—can significantly increase students' motivation.

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Research by Selviani and Anggraini (2018), concluded that e-magazines can be distributed effectively in digital formats, such as PDFs or soft flipbooks, which can be easily accessed by students. Scientific literacy refers to an individual's ability to understand, communicate, and apply scientific concepts to solve real-world problems (Toharudin, 2011). Previous studies have explored chemical literacy, emphasizing that students' understanding of science improves when digital learning media are combined with direct interaction between teachers and students.

Often, students are unaware of the real-life applications of chemistry. Chemistry is frequently taught without relating it to daily life, even though colloidal materials play a significant role in everyday activities. Many students struggle with colloids because they fail to recognize their practical applications. To enhance their understanding, it is essential to highlight the relevance of colloidal materials beyond formulas and calculations, emphasizing their role in daily activities.

Based on this perspective, chemistry education should be engaging, interactive, and creative to motivate students and encourage a deeper understanding of the subject. By utilizing a digital format that incorporates videos, animations, and audio, chemistry lessons can become more dynamic and effective. Therefore, this study focuses on the development of an e-magazine oriented toward chemical literacy on colloidal materials.

Methods

Before the product is tested for eligibility by respondents, suggestions for improvement are gathered. The Design-Based Research (DBR) approach was chosen as the method because it is appropriate for objective studies, specifically in creating a product that supports the learning process (Aldoobie, 2015). The study results will take the form of a learning media product—an e-magazine focused on colloid material. The research follows the phases of the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). However, in this study, only the first three phases—analysis, design, and development—were applied, as the focus was on product development and step-by-step testing of its validity and feasibility (Sugihartini et al., 2017).

The first stage, Analysis, involves evaluating the need for an e-magazine to enhance and expand learning. The needs analysis is based on the relevance of content, material accuracy, and the e-magazine's visual presentation. Additionally, the analysis considers four dimensions of chemical literacy: context, content, process, and attitude.

The second stage, Design, involves determining the target users, creating instrument flowcharts and storyboards, and selecting appropriate software for e-magazine development. At this stage, relevant materials, images, videos, and other supporting components related to colloid material—aligned with chemical literacy—are collected for inclusion in the e-magazine.

The third stage, Development, focuses on refining the design to meet the research objectives, specifically the development of a chemistry-oriented e-magazine on colloid materials. This stage heavily relies on the findings from the analysis and design phases. The e-magazine is created based on the storyboard developed in the design phase. The product is then validated by three experts: two subject matter experts and one media expert. The validation process aims to assess the initial version of the product and gather feedback for improvements before it is tested for eligibility by respondents.

The study collects two types of data: qualitative and quantitative. Qualitative data includes explanations of the e-magazine's appearance and its role in enhancing the understanding of colloid materials within the context of chemical literacy. This explanation is based on the tools used to create the e-magazine, including channel diagrams and storyboard sequences. Meanwhile, quantitative data consists of numerical evaluations indicating the quality of the product and the e-magazine. These evaluations are obtained through validation surveys conducted using questionnaires. The validation process involves experts in both subject matter and media, as well as an eligibility assessment conducted by 15 students who have studied colloid materials.The data collection technique used in this study involved administering a validation test questionnaire to expert validators and an eligibility test questionnaire to student respondents. The validation test questionnaire was designed to assess the suitability of interactive multimedia with a chemistry literacy orientation from the perspectives of subject matter experts and instructors (lecturers). The media is considered valid if the calculated correlation coefficient ($rhitung$) exceeds the critical correlation coefficient ($rkritis$). If the $rhitung$ value is lower than the $rkritis$ value, the media is deemed invalid (Arikunto, 2006). The $rhitung$ value is determined using the following formula:

$$r = \frac{x}{\mathrm{N}.n}$$

r = Validity value

N = maxium score

x = weight of respondent"s

n = number of respondents

The processed data results will be analyzed and utilized as an instrument to assess the suitability of the produced product.

Tabel 1. Interpretation of validity test

Validity Value	Interpretation
0.10≥ r ≤0.20	invalid
0.20≥ r ≤0.40	less Valid
0.40≥ r ≤0.60	Quite Valid
0.40≥ r ≤0.80	Valid
0.80≥ r ≤1.00	Very Valid

Data processing for the feasibility test questionnaire using the Guttman scale was conducted by summing all the marks. The total score was then converted into a percentage. The formula for calculating the eligibility percentage is as follows:

$$\% \, kelayakan = \frac{\Sigma n}{N} \, x \, 100$$

Results and Discussions

The The data analysis covers the study, referring to the problem formulation in Chapter I. This includes evaluating the appearance of the e-magazine, which focuses on chemical literacy in the context of colloidal materials, as well as the validation test results and feasibility test outcomes. The research data was obtained through a validation test sheet assessed by two lecturers and one teacher as validators. They evaluated the e-magazine based on three aspects: material, language, and appearance. Additionally, research data was gathered from a feasibility test questionnaire and responses from twelve chemistry education students who served as respondents for the e-magazine.

During the analysis stage, a concept and concept map were developed as an initial step to determine the key topics to be discussed in the e-magazine. The purpose of drafting this analysis was to create a systematic and precise structure. The colloidal material covered in the e-magazine is based on chemical literacy, encompassing the colloidal system, types of colloids, characteristics of colloids, and methods of preparation.

The presentation order in the e-magazine follows a chemical literacy-oriented approach, covering four aspects: context, content, process, and attitude. These aspects are arranged as effectively as possible in a flowchart to ensure that all colloidal material concepts are delivered clearly. The flowchart serves as the foundation for the storyboard, which forms the initial design of both the content and appearance of the e-magazine in a systematic manner.

The front cover page features the title "Colloid System," reflecting the primary topic discussed in the e-magazine. It includes the UIN Sunan Gunung Djati Bandung logo, the text "E-Magazine," and an illustration of a coconut as a representation of colloidal material. The description page explains the target readers and the objectives of developing the e-magazine. Meanwhile, the back cover contains the title of the e-magazine and an illustration that aligns with the front cover design.

Figure 1: Cover Display **Figure 2**: Description Page **Figure 3.** Back Cover

The presentation of the Tyndall effect is illustrated in the context of everyday life using a mixture of milk and water. When a laser light is passed through this mixture, the path of the light becomes clearly visible. This phenomenon occurs because colloidal particles are larger than the wavelength of light, causing scattering. The section also introduces the history of the Tyndall effect, featuring an illustration of its discoverer, John Tyndall, along with a thought-provoking question to engage the reader. Additionally, the phenomenon of clouds is presented as an example of the Tyndall effect in nature.

The explanation of Brownian motion includes a clear definition along with a discussion of the factors that influence it. This section also features illustrations to help visualize the concept of Brownian motion effectively.

Figure 4. Tyndall Effect Material

Figure 5. Tyndall Effect Material

Figure 6. Tyndall Effect Material

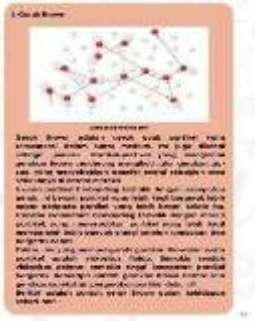

Figure 7. Presentation of Brownian Motion Material

Figure 8. Presentation of Brownian Motion Material

The presentation of colloid formation covers the condensation method. This section explains the types of reactions that can produce colloids, including metathesis reactions and the resulting equilibrium processes.

Figure 9. Presentation of Colloid Preparation Material

Figure 10: Presentation of Colloid Preparation Material

Providing reading materials to assist readers in answering questions. This page also includes questions designed to help readers evaluate their understanding independently, guiding them to apply their knowledge, explore various solutions, and take action.

Figure 11. This or That

This page contains the author's profile information, including details such as name, place and date of birth, and educational background. It also features a photo and the identity of the lecturer who guided the author in creating the e-magazine.

Figure 12: Author Profile Display

The validation process aims to assess the quality of the chemistry-oriented e-magazine on colloidal materials and provide feedback for improvements in terms of content presentation, language, and appearance. This ensures that the e-magazine is suitable for use as an educational resource. The validation test was conducted by two lecturers and one teacher, who are experts in both subject matter and media.

The validation process involved an assessment questionnaire, which was completed by the validators after reviewing the entire e-magazine. The evaluation focused on three key dimensions: content, language use, and appearance. Based on this assessment, the researcher was able to make necessary revisions according to the recommendations provided by the three validators.

The content presentation of the e-magazine, which is oriented toward chemical literacy in colloidal materials, was validated and categorized as highly suitable for use as a learning medium. Additionally, the language aspect was reviewed, focusing on accuracy in spelling, terminology, punctuation, sentence structure, consistency in scientific and foreign terms, and overall readability. The validation results indicated that the language used in the e-magazine was of a very good standard for learning purposes.

Beyond content and language, the visual aspect also plays a crucial role in determining the quality of an e-magazine, as it enhances reader engagement. The appearance aspect includes the suitability and arrangement of text, objects, and images; color harmony; font selection; and the proportionality of illustrations and text.

Tabel 2. Result Test Validation

Aspect Which rated	r_{hitung}	r_{kritis}	Result
Aspect material	0.93	0.3	Valid
Aspect Language	0.97	0.3	Valid
Aspect Appeara nce	0.98	0.3	Valid

After validation and revisions were completed, several suggestions were made, including improving sentence structure, using clearer images, and making the language more familiar and engaging. The feasibility test was then conducted with 12 respondents. Among them, eight were chemistry education students, while the remaining seven

were non-chemistry education students, selected randomly. The purpose of this test was to assess the feasibility of the e-magazine as a learning medium.

The feasibility test was conducted by distributing a questionnaire along with a link to the e-magazine, which was accessible online. Respondents were also provided with explanatory videos and the e-magazine itself to gather feedback in the form of assessments and suggestions for improvement. The evaluation covered aspects such as content presentation, language, and overall appearance.

In terms of content, respondents assessed the material's clarity and comprehensiveness. The most prominent criteria included the clarity of content descriptions in each section, the extent to which the e-magazine covered aspects of chemical literacy (context, content, and process), the relevance of illustrations to the material, and the appropriate placement of videos—each receiving a 100% approval rate. Other criteria, such as the inclusion of chemical literacy aspects related to attitudes (80%), the provision of concrete examples (86%), and the clarity of material descriptions (66%), were also evaluated. Overall, the feasibility test for content received an average score of 93%, indicating that the e-magazine is highly suitable as a learning resource for chemistry.

For the language aspect, respondents evaluated the clarity and readability of the text. The most notable criterion was the ease of understanding the language, which received a 100% approval rate. Other aspects, such as spelling, terminology, and punctuation, scored 86%, while sentence structure received 73%. The consistency of scientific and foreign terms was rated at 66%. Overall, the language aspect of the e-magazine achieved an average feasibility score of 82%, confirming that it is well-suited for instructional use.

Regarding the appearance, respondents assessed the layout and visual elements of the e-magazine. The highest-rated criteria included the organization of text, objects, and images, ensuring that illustrations and videos effectively complemented the material—this received a 100% approval rate. Other aspects, such as color combinations, object proportions, illustration placement, and text clarity, received high ratings. The typeface and font size were considered clear, easy to read, and visually appealing. The overall layout, including the cover design, received a score of 93%, while text formatting alignment within the e-magazine was rated at 86%. Based on these results, the e-magazine is deemed highly feasible and ready to be used as an effective instructional medium for learning chemistry, particularly in the context of colloidal materials.

Tabel 3. Results Feasibility test

Aspec t Which rated	Percentage average	Interpretati on
Aspect material	93.00%	worthy
Aspect Language	82.00%	worthy
Aspect appeara nce	95.00%	worthy
Total Percentage Average	90.00%	worthy

Based on the results, the feasibility test for the material presentation aspect received an average score of 93%. Among the criteria assessed, the most prominent one—agreed upon by 100% of respondents—was the clarity of content and material descriptions. This aligns with Andrew et al. (2020), who states that learning materials should be engaging and easily understood by students.

Meanwhile, the average percentage for the language aspect reached 82%, with the most notable criterion being its ease of comprehension. This suggests that the content presents scientific concepts in a way that is accessible and enjoyable to read, reducing the perception that scientific writing is rigid and overly complex (Timansyah, 2018). For the display aspect, the feasibility test yielded an average score of 95%, with layout being the most highly rated criterion. The text, images, and illustrations were well-structured, and the placement of visuals and videos effectively supported the content, making the e-magazine efficient and easy to use. This aligns with Bozkurt (2015), who emphasizes that media design should adhere to principles of simplicity, integration, emphasis, and balance while considering visual elements such as lines, textures, and colors.

Overall, the e-magazine focuses on chemical literacy in colloidal materials and has been validated as a suitable educational tool. This is evidenced by its evaluation scores: 93% for content, 82% for language, and 95% for design, averaging 90%. These findings align with Kariadinata (2012), who states that products with a qualification percentage of 90–100% are considered highly suitable, 80–89% are deemed appropriate, 70–79% are sufficient, 60–69% are less suitable, and below 60% are considered unsuitable.

Based on this validity and feasibility evaluation, the e-magazine has been proven to be both valid and highly suitable as a tool for chemistry learning and as a source of knowledge for the general public. However, there remains an

opportunity for further development to address existing limitations, enhancing its effectiveness in chemistry education for students and broader audiences alike.

Conclusions

The e-magazine on colloidal materials is integrated with aspects of chemical literacy. Its layout consists of a front cover, an introduction to the e-magazine, four sections (colloidal systems, types of colloids, colloidal properties, and their production), a bibliography, an author profile, and a back cover. The e-magazine is designed with engaging visuals, including images and videos, and uses interactive and persuasive language, making it more appealing to read. It is also accessible online, allowing users to learn independently and effectively. The validation test results for the e-magazine, which focuses on chemical literacy in colloidal materials, show an average r-value of 0.93 for content, 0.97 for language, and 0.98 for design. Since these values exceed the critical threshold of 0.3, the e-magazine is considered valid. The feasibility test results indicate a suitability percentage of 93.00% for material presentation, 82.00% for language, and 95.00% for design. These findings confirm that the e-magazine is highly suitable as a learning medium for chemistry education.

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