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Development of Powtoon Animation Video on Colligative Properties of Contextually Charged Solutions to Increase Student Learning Motivation

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Abstract: Advances in the digital era have significantly changed the presentation of learning materials, with the increasing use of interactive animated videos in the classroom. This study aims to develop and assess the quality of Powtoon animation videos on the material of colligative properties of contextually charged solutions to increase student learning motivation. The method used is research and development (R&D) with the 4-D model from Thiagarajan (1974) to the development stage. The developed products were assessed by material experts, media, and educational practitioners using product quality assessment sheets and student responses. Material experts assessed 91.10%, media experts 100%, reviewers 94.20%, and students assessed 93.00% of the developed video. Based on the data collected, the experts, reviewers, and students considered their assessments to fall into the "outstanding" category. Based on the data obtained, the Powtoon animation video developed is suitable for use as an alternative media in learning the chemical properties of colligative solutions to increase student learning motivation.

Keywords: Colligative properties of solution; Contextual; Learning media; Powtoon animation video; Student motivation

Introduction

The development of educational technology in the industrial era 4.0 has revolutionized the face of education in Indonesia (Saputra, 2020). *Educational technology* is an innovative tool that improves the efficiency and effectiveness of the learning process (Agustian & Salsabila, 2021). Technology can improve students' attention, concentration, motivation, and independence (Nasution, 2018). Educational technology can also reduce teachers' time delivering material and make learning fun and exciting (Aka, 2017). Therefore, teachers should not be technology illiterate and must continuously improve their ability to use technology (Gazali & Pransisca, 2020), this is in line with the Regulation of the Minister of National Education, which advocates the use of information technology in the education process (Rudini & Saputra, 2022). Teachers are required to master educational technology in order to produce a generation that is internet and technology-literate (Mulya, 2024). However, in reality, many educators in the field have yet to utilize educational technology to help achieve learning objectives in the classroom (Miasari et al., 2022).

One educational technology innovation that supports the learning process is Powtoon (Astuti et al., 2021). Powtoon is a presentation media in moving animations equipped with backgrounds and transitions that make learning material enjoyable (Julia et al., 2022). Animation from Powtoon can increase student learning motivation (Marta et al., 2023), arouse students' thought processes on subjects (Qurrotaini et al., 2020), attract students' attention, and bring direct examples of events into the classroom (Wouters et al., 2019). Powtoon has

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fantastic animation features, including handwriting, cartoons, transitions, and a simple timeline (Ningsih, 2021). Powtoon can present material in a more enjoyable, varied, and fun way to make the information conveyed easier to remember (Lestari & Dewi, 2020). Therefore, teachers should be able to use and develop learning media like Powtoon animated videos to facilitate the learning process and increase student motivation (Shalikhah, 2017). However, the fact is that many teachers continue to use media such as PowerPoint and textbooks in learning. As a result, they make students bored and need help understanding what is being taught (Wulandari et al., 2020). The interview results show that chemistry teachers in Yogyakarta high schools are unfamiliar with the Powtoon platform and have never used it in teaching. The results of research conducted by Pilendia et al. (2023) revealed that 88.90% of teachers have never used Powtoon, but all teachers showed interest in attending training on Powtoon-based learning media.

Chemistry is classified as a complex subject for some high school students (Syamsudin et al., 2022). One of the materials that are difficult to study in chemistry is the colligative properties of solutions (Pradnyamita et al., 2019). The colligative properties of solutions include a decrease in vapor pressure, a reduction in freezing point, an increase in boiling point, and osmotic pressure (Naswir et al., 2017). The material of the colligative properties of solutions contains many abstract concepts (Akbar, 2016). Abstract concepts in colligative solution material include forces between particles, the concept of solution and evaporation, and phase changes (Harling, 2022). Students are asked to complete calculations about solutions' colligative properties and understand the concepts (Siregar & Lubis, 2022). Many students need help understanding the concept of colligative properties of solutions, as evidenced by the results of many tests that do not reach the Minimum Completeness Criteria (Mairisiska et al., 2014). According to research conducted by Hubbi et al. (2017) on the material of colligative properties of solutions, as many as 53.00% of students have yet to reach the Minimum Completion Criteria value of 75.

The low mastery of students' concepts can be overcome by choosing a learning approach appropriate to the material in the learning process (Oktaviani & Ayu, 2021). One approach that can improve students' mastery of concepts is the contextual approach (Handayani, 2015). A learning method known as the contextual approach connects subject matter to everyday situations (Zakiyah et al., 2019). This method encourages students to link their knowledge with its real-life application (Latief, 2016). Contextual learning also helps teachers connect lessons to real-world situations. This helps students understand the lesson more easily (Satriawan & Rosmiati, 2017). The contextual approach is essential because students who understand concepts theoretically will need help linking and utilizing them in the real world (Jundu et al., 2020). Learning that uses a contextual approach can increase student interest and provide direct benefits for them (Primayana et al., 2019). In addition, students will also have enthusiasm for learning (Buchori, 2019). As a result, students have high learning motivation to improve their learning outcomes (Suprapto, 2015).

Motivation is one factor that determines student learning outcomes (Muhammad, 2017). Without motivation, learning activities can become passive (Ilmiyah & Sumbawati, 2021). Motivation can increase student enthusiasm, raise curiosity, and encourage participation (Krismony et al., 2020), feel happy and excited (Gianistika, 2021), and learn harder and concentrate on the learning process (Yanti & Saputra, 2018). Students have better learning achievement with higher motivation (Pratama, 2019), and vice versa; the lower the achievement motivation, the lower the achievement results obtained (Fadillah, 2018). Therefore, the role of teachers in arousing and increasing student motivation is vital (Melinda & Susanto, 2018). However, student motivation in learning still needs to improve (Widiyasanti & Ayriza, 2018). Students' low motivation can be seen from their lack of class participation (Suratman et al., 2019) and their tardiness in the classroom (Amma et al., 2021). This results in poor student learning outcomes (Putri et al., 2017).

Considering the above problems, this study aims to produce Powtoon animation videos that use colligative solution material with a contextual approach to increase the learning motivation of XII-grade students. The innovation of this study is the combination of contextual approach and Powtoon animation media; these two methods have yet to be widely applied in teaching chemistry materials, primarily abstract concepts such as the colligative properties of solutions. With this combination, the learning video can help students understand the material and its relation to everyday phenomena. In addition, teachers will find it easier to explain abstract concepts to make them more accurate in teaching chemistry.

Method

This research uses a research and development (R&D) approach to create and test how effective the product is (Sugiyono, 2019). The product developed is a Powtoon animated video containing contextual content. The development model applied is the 4D model, which consists of four stages: define, design, develop, and

disseminate (Thiagarajan et al., 1974). This model was chosen because it is suitable for learning media design and involves assessment from experts (Supriadi & Hignasari, 2019). This research follows the 4D model until the development stage. Figure 1 below shows a modification of the 4D development model.

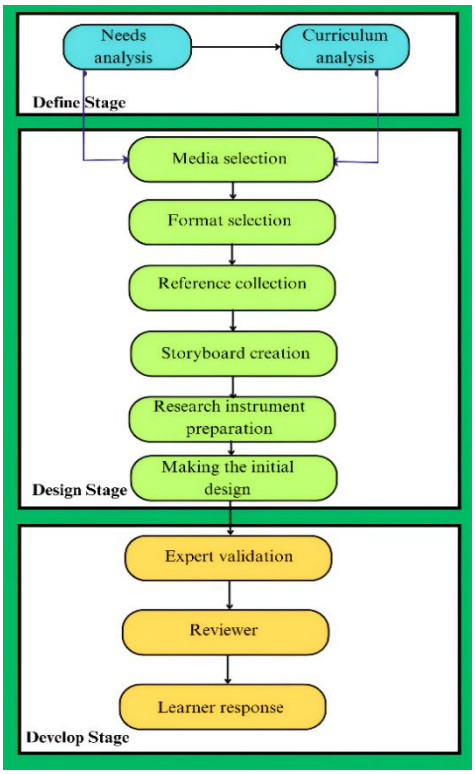

Figure 1. Modification of the 4D development model

The definition stage of the research includes needs and curriculum analysis. The aim was to determine what was needed, whether contextualized Powtoon animation videos were available, and information about product development. This analysis involved interviews with chemistry teachers and grade XII students at one of the high schools in Yogyakarta. The planning stage aims to create a Powtoon animation video that emphasizes the topic of solutions' colligative properties. This process includes media and format selection, reference collection, storyboarding, instrument preparation, and initial design drafting. The purpose of the development phase is to collect assessment and validation data from material experts, media, and assessors (grade XII chemistry teachers) to ensure product quality. After that, the products that have been developed are tested on students to get suggestions and responses.

In this study, the validators consisted of one lecturer who was an expert in the material, one who was an expert in the media, four chemistry teachers from grade XII who served as assessors, and ten grade XII students who provided feedback on the products that had been made. The data used is to validate and evaluate the product. The research tools include a questionnaire that assesses the quality of the product filled in by lecturers of, material experts, media expert lecturers, and chemistry teachers using a Likert scale, as well as a Guttman questionnaire to collect student feedback.

Data analysis techniques for product quality assessment by experts and reviewers were carried out by converting qualitative assessments into quantitative (scores) using a five-point Likert scale. The scores obtained were then calculated on average for each assessment aspect. Furthermore, the results of this calculation were converted into qualitative data using the ideal assessment criteria listed in Table 1 (Widoyoko, 2017).

Table 1. Ideal Assessment Criteria

Category Score	Range
$Xi + 1.8\ SBi < X$	Very Good
$Xi + 0.6\ SBi < X \leq Xi + 1.8\ SBi$	Good
$Xi - 0.6\ SBi < X \leq$	Fair
$Xi - 1.8\ SBi < X \leq Xi - 0.6\ SBi$	Less
$X \leq Xi - 1.80\ SBi$	Very Less

Result and Discussion

The purpose of this study was to develop and assess the quality of Powtoon animation videos based on the colligative properties of contextually charged solutions. Animated videos were chosen because many students are interested in watching cartoons and animations (Hanif, 2020) and are effective in attracting their attention through attractive images (Rabiasa et al., 2024). The software used to edit the video consisted of Canva and Capcut, combined with Powtoon animation. Canva was chosen because it is a graphic design platform that offers ready-made templates, complete tools, intuitive editors, and cloud collaboration features (Sari et al., 2024) and provides various attractive elements such as templates, text, and videos (Larasati & Roidah, 2023). Meanwhile, Capcut adds music, merges, and cuts videos as needed (Yulius & Sartika, 2022). Powtoon was chosen because it is a free web application that provides animations that attract students to watch videos (Susanti et al., 2020) and is a motivational tool to make the material more interactive (Rioseco et al., 2017). Therefore, Powtoon makes videos easier for students to understand (Sun & Kwak, 2024).

The animation features available in Powtoon, such as handwriting animation, cartoons, dynamic transition effects, and accessible timeline settings, support better understanding (Anggraeni et al., 2024). Research by Karame et al. (2024) also shows that animated videos' dynamic and interactive nature can attract attention and maintain student interest during learning. In addition,

Powtoon presents more real animation in learning videos, which significantly affects student learning outcomes (Nurmahasih & Wiyono, 2024). Animation is a learning medium because it can help understand abstract concepts (Apriyanti et al., 2023), reduce the impression of monotony, and attract more student attention (Hamidi et al., 2023). In addition, Powtoon animation-based learning media is also easier to accept and understand and can motivate students to learn (Suharyono, 2022). Research by Pasaribu et al. (2022) shows that Powtoon animation-based learning media can increase student motivation. This research adopts the 4-D model from (Thiagarajan, 1974), which is limited to the development stage. The following are the stages of the research conducted.

Define Stage

The define stage includes analyzing needs and curriculum to identify learning problems. The needs analysis was conducted through literature studies and interviews, while the curriculum analysis involved a review of the Learning Outcomes and Objectives. Based on interviews with chemistry teachers at SMAN 1 Turi and SMAN 1 Tempel, it is known that learning media such as PowerPoint, modules, and LKS cannot explain abstract chemical concepts effectively, resulting in low student interest and learning outcomes. One of the materials that are difficult to understand is the colligative properties of solutions. The same thing was also found at SMA 1 Sleman, where students revealed that learning methods that only relied on teacher explanations and practice questions caused boredom.

Research by Caella et al. (2024) showed that animated videos can increase student enthusiasm, focus, and engagement. Mulyani et al. (2024) also added that video media can develop students' cognitive, affective, psychomotor, and interpersonal skills (Syafutry et al., 2024) revealed that the combination of visuals and sound in videos makes it easier for students who have weak abilities to understand the material. Animated videos offer unique advantages over live-action videos (Karakolidis et al., 2021). This advantage can be seen from the increased student learning motivation, which can occur because the moving visual elements in animated videos attract attention (Setiawan et al., 2024; Tugtekin & Dursun, 2022). Therefore, animated video-based learning media is essential for chemistry lessons because it can attract students' attention, increase motivation, and concretize abstract concepts.

Design Stage

The design process consists of several vital steps. These include selecting the media, determining the format, gathering references, creating storyboards, creating assessment tools, and making initial drafts. The first step was to determine the media according to the interview results, which led to the decision to make a Powtoon animated video containing the context of the material on the solution's colligative properties. Next, the video format was selected. Research Cookson et al. (2020) shows that students are more motivated to learn through videos because of their attractive format. The video format developed includes an opening section, an introduction to the characteristics of the contextual approach with elements of constructivism, questioning, modeling, and reflection, and ends with a closing.

After the storyboard was completed, instruments were created to be used by material experts, media experts, and reviewers to evaluate the quality of the product. The assessment aspects include material clarity, language, contextual suitability, ability to increase motivation, and overall video quality. Student responses were evaluated based on material, language, contextual relevance, presentation, and media benefits. Before use, the instruments were validated to ensure their reliability and accuracy. The final step in the design process is to create an initial design draft, which will be used to create the final product.

In this research, the initial design process begins with preparing material about the colligative properties of solutions that are relevant to the phenomenon of everyday life in the form of a script. After the script was completed, the animation video was created using several tools, namely the main application Powtoon for animation creation, Canva for finding supporting elements, as well as additional websites such as https://www.remove.bg/ to remove the background of the image in JPG format, and www.unscreen.com to remove the background of the animation in GIF format. This stage also involved determining the layout of animations and text in Powtoon according to the material script that had been compiled, as illustrated in Figure 2.

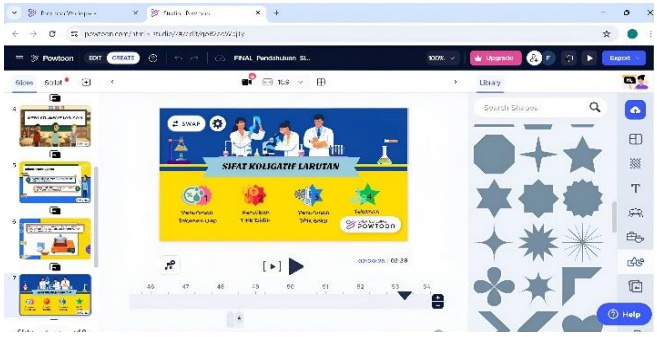

Figure 2. The process of creating animated videos using the Powtoon web app

Supporting elements are also essential as they can clarify the message, maintain a consistent style, and

enhance the video's visual and aesthetic quality. Supporting elements also make the video more exciting and effective in attracting students' attention and engagement. Therefore, decorations or supporting elements should be added using the Canva application, as shown in Figure 3.

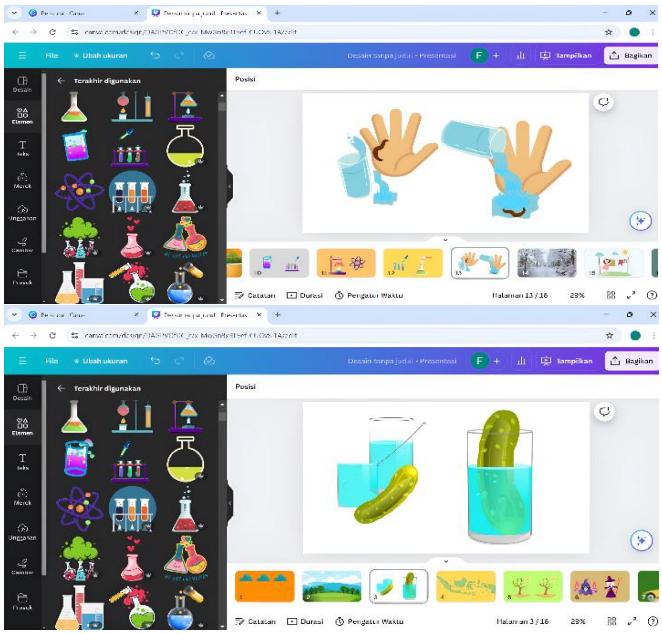

Figure 3. The process of editing supporting elements using the Canva application

In the third stage, dubbing recordings follow the script to reduce errors. Next, all components, such as raw footage from the Powtoon design, dubbing, sound effects, and background, were inserted into the CapCut app. This process combines visual elements, text, audio, and animation effects into a video that presents information comprehensively, as seen in Figure 4.

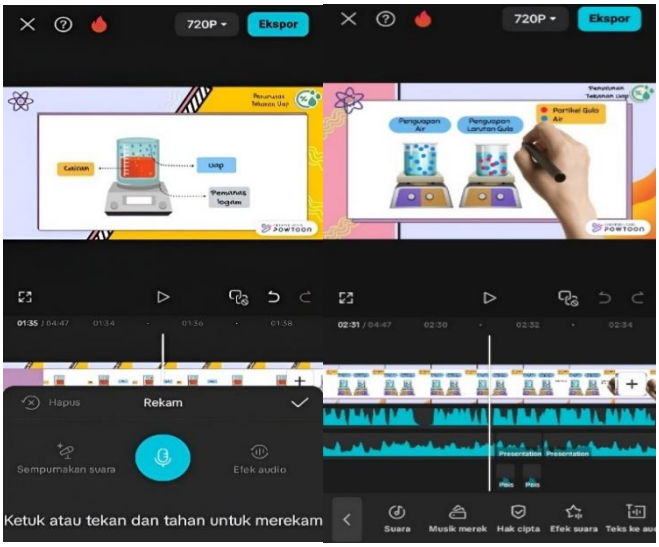

Figure 4. Dubbing and editing process using the capcut application on a smartphone

The final stage in this process is publication. The animated video is generated in .mp4 format with 2K (2560x1440 pixels) or 4K UHD (3840x2160 pixels) resolution, which is much better than standard HD resolution (1280x720 pixels or 1920x1080 pixels). With a frame rate of 60 fps, these videos feature ultra-smooth motion and optimized detail, ensuring an immersive and mesmerizing visual experience for students.

The final product produced is a PowToon animated video on the material of colligative properties of contextual solutions, consisting of 7 videos with a duration of between 2-5 minutes. Each video is made with the format: opening, characteristics of the contextual approach, and closing. The opening section displays the opening greeting, author's name, title, and learning objectives, as shown in Figure 5.

Figure 5. The opening section of the video

The contextual approach is one of the learning alternatives that can create conducive classroom situations and conditions, activate students more (Zuhri & Rizaleni, 2016), and bring real-world situations into the classroom (Suarjana et al., 2017). According to Solihah (2018), constructivism, questioning, research, learning communities, modeling, and authentic assessment are components of the contextual approach. The contextual approach in this video includes four characteristics: constructivism, questioning, modeling, and reflection. The video applies constructivism by presenting a real scenario that provides an immersive and relevant learning experience. The video begins with the setting of a city facing extreme winter, where ice on the roads is a severe problem as temperatures drop below 0°C. The city government is considering the use of salt to melt the ice. This video shows a simulation where salt is added to ice water, and the effect of lowering its freezing point is observed. This process helps students understand how solutes affect the colligative properties of solutions by seeing how salt ions interfere with the formation of ice crystals. This approach allows students to learn and apply theory in a natural context, making learning more relevant and

enjoyable. An example of the application of constructivism in the video can be seen in Figure 6.

Figure 6. Constructivism characteristics section of the video

The second characteristic is questioning, which relates concepts to real situations to make them easier to understand. Questions in the animated video, such as 'What if we add sugar to heated water?' or 'What happens if a container of water is left open?' encourage critical thinking and connect theory with practice. This approach makes learning more meaningful and relevant. If done correctly and delivered correctly, questions can enhance active learning and student participation in the learning process and develop students' mindsets (Rizki & Makki, 2023). Some questions in the video are displayed to attract attention and stimulate critical thinking, as shown in Figure 7.

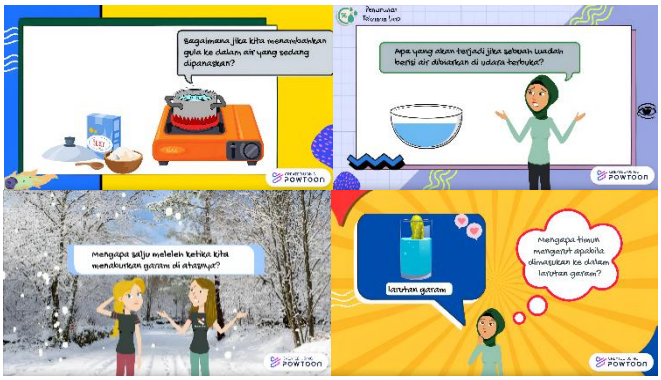

Figure 7. The questioning characteristics section of the video

Modeling involves examples encouraging students to think, work, and learn to facilitate understanding (Triani & Putra, 2023). In the video, modeling uses visualizations such as the evaporation of a liquid, the decrease in vapor pressure, the decrease in the freezing point of a solution, the shrinking of a cucumber, and the release of leeches in salt water. The modeling section can be seen in Figure 8.

Reflection is a way of thinking about what happened or was just learned (Syafriza & Ummah, 2022). It is the final stage of learning that helps students review, record, and enrich their understanding of the material they have learned. In the video, the reflection characteristics are displayed by summarizing the entire colligative properties of the solution. This reflection video is separate from the previous materials. The display of reflection characteristics in the video can be seen in Figure 9.

Figure 8. The modeling characteristics section of the video

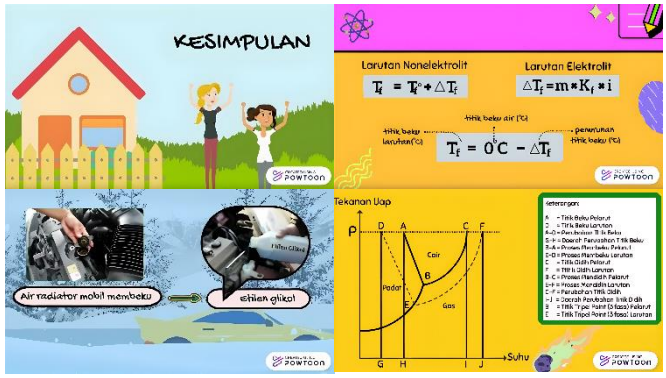

Figure 9. Characteristic reflection section of the video

The last format is closing. The closing section contains a conclusion, a description of the following material, and a thank you. The closing section of the video can be seen in Figure 10.

Figure 10. The closing section of the video

This animated video uses audio elements, illustrations, and animated characters to help students

understand abstract concepts. Illustrations such as images, videos, and GIFs clarify the material, while animated characters like teachers explain and greet students interactively. Based on research Karuana et al. (2023), combining subject matter with animation, music, and graphic elements can attract students' attention while increasing their focus during learning.

According to research by Toharudin et al. (2023), the popularity of Powtoon allows the creation of high-quality animated films compared to ordinary videos. Research by Zamora et al. (2021) also shows that Powtoon is an effective alternative for creating meaningful learning, helping students reflect and review the information obtained. Research by Susilo et al. (2021) confirms that animation media with audio-visual elements can provide significant learning motivation to students.

Develop Stage

One material expert and one media expert assessed and validated the product. The material expert evaluated the material, linguistic, contextual, and motivational aspects, while the media expert assessed the video aspects. After being revised based on the experts' suggestions, the product was assessed by four grade XII chemistry teachers who evaluated the same elements. Furthermore, the responses of ten students to the developed product were also evaluated. The assessment results from media experts, material experts, reviewers, and students are presented in Table 2.

Table 2. Results of Product Quality Assessment and Student Responses

Assessment/response	Assessment aspect	Ideal percentage %	Criteria
Material expert	Material Language Contextual Motivation	91.10	Perfect
Media expert	Video	100	Perfect
Reviewer	Material Language Contextual Motivation Video	94.20	Perfect
Student	Material Language Contextual Presentation Motivation	93.00	Perfect

Table 2 shows that the material experts, media experts, and assessors each have an expected percentage of 91.10%, 100%, and 94.20%, all of which fall into the excellent category. These results indicate that the material explaining the colligative properties of solutions in the animated video is presented systematically and clearly. The material has sufficient depth, uses clear language, and is organized systematically to be delivered. The suitability of the material with learning outcomes and objectives in the independent curriculum is evidence of a systematic and straightforward presentation of the material. The material presented interestingly according to these criteria will be easier to understand, motivate students, and not be bored in learning (Dewi & Lestari, 2020). Learning videos focusing on everyday phenomena can help students understand the subject (Febliza et al., 2021). The animated video developed meets the criteria of suitable media, including clear dubbing sound, supportive sound effects, contrasting colors, appropriate video effects, and proportional typography. Based on the assessment results, animated videos discussing solutions' colligative properties are considered feasible as an alternative method to increase student motivation.

The response of XII grade students at SMA 1 Sleman to this animation video was very positive, with an idealized percentage reaching 93.00%, classified as very good. Students stated that this video increased their learning motivation because it related the material to everyday phenomena. Learning motivation arises from the desire, need, and drive to participate and succeed in the learning process (Sucia, 2017). This aligns with Haryadi et al. (2021), who found that contextual teaching materials can motivate students and encourage them to participate more actively in their learning. In addition, Istiqomah et al. (2024) prove that Powtoon-based learning videos on solar system material effectively increase student motivation and can be a reference to overcome the lack of innovative learning media in schools.

Conclusion

To increase students' enthusiasm for learning, this study designed and evaluated the quality of Powtoon animation videos that raised the theme of the colligative properties of solutions. The ideal percentages were 91.10%, 100%, and 94.20%, respectively, based on assessments from material experts, media experts, and reviewers. Ten students gave positive feedback, with 93.00% rated as excellent. The assessment results show that this animated video can act as a learning aid, supporting the learning process and increasing student motivation to learn, especially regarding the concept of colligative properties of solutions in everyday life.

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Author Contributions

Conceptualization, F.W, and A.K; methodology, F.W and A.K; validation, A.K; formal analysis, F.W and A.K; investigation, F.W, and A.K; resources, F.W and A.K; data curation, F.W; writing-preparation of the initial draft, F.W; author-review and editing, A.K; All authors have read and approved the published version of the manuscript.

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

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