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Developing Digital Microlearning Content on Reaction Rates Using Wix for Senior High School

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Abstract

Reaction rate concepts in high school often lack submicroscopic depth and are not supported by digital media that match Generation Z's preferences for interactive learning. This study developed a Wix-based microlearning platform for 11th-grade students featuring videos, infographics, quizzes, worksheets, games, and modules. Using the ADDIE model, the platform was evaluated by experts and tested in the classroom. Expert validation showed high feasibility (91.94% from content and language experts, 90.40% from media experts). Large-scale trials with students and teachers also yielded high acceptance (93.25% and 93.23%, respectively). These findings support the platform's feasibility and effectiveness in enhancing chemistry learning, especially for teaching reaction rates.

1. Introduction

Chemistry is a fundamental subject in science education as it explains the composition, properties, behavior, and transformation of matter, playing a crucial role in daily life [1]. Research indicates that the reaction rate is one of the most challenging topics for students to understand [2]. Further studies reinforce this by stating that reaction rate involves abstract concepts, defined concepts, mathematical calculations, graphs, and multiple representations (macroscopic, submicroscopic, and symbolic). Traditional teaching methods often focus only on macroscopic and symbolic levels, while neglecting the submicroscopic level, making it difficult for students to grasp the concept of reaction rate [3]. As a result, students develop a low level of conceptual understanding, which is closely related to their cognitive load in processing and integrating information across different levels of representation. Each student has varying working memory capacities. This limited working memory capacity affects their ability to absorb information, especially when faced with a large amount of complex information [4].

In the learning process, presenting materials through multimedia products such as e-learning enables students to process information and engage in interactive experiences. This approach enables them to absorb content through various media. However, a needs analysis conducted by the researcher on chemistry teachers at SMA Negeri 102 Jakarta (State Senior High School 102 Jakarta) revealed that, to date, teachers have not utilized e-learning or online platforms as a medium for teaching chemistry, except for YouTube. This finding aligns with previous research [5], which states that although technology has been integrated into education, its implementation remains limited, often serving merely as a communication tool between educators and

students, such as through WhatsApp, Zoom Meetings, and YouTube.

Education in the Industry 4.0 era plays a crucial role in shaping Generation Z, also known as the iGeneration. As a result, the educational process must adapt to the significant changes brought about by technological advancements. Having grown up in a digital environment, Generation Z perceives limitations in the current education system. Consequently, it is essential for school learning to actively integrate digital media to enhance student engagement [6, 7]. Teachers must adapt their strategies, models, and methods to align with students' characteristics. Beyond mastering educational theory and its applications, they must also develop technical skills to utilize and implement various e-learning tools and environments effectively [8]. This approach aligns with Indonesia's new curriculum policy, Merdeka Belajar (Independent Learning), which aims to transform and enhance the learning process. The Merdeka Curriculum requires teachers to be more creative in designing learning materials and assessments [9]. Its implementation necessitates the use of engaging, technology-based interactive learning media that align with technological advancements and capture students' attention with visually appealing elements [10, 11].

Information and communication technology (ICT)-based teaching materials that align with current educational developments can be implemented through microlearning. Research indicates that microlearning can enhance educational achievement, particularly in students' learning patterns and memory retention [12]. Microlearning presents information in precise amounts to reduce students' cognitive load and achieve learning objectives efficiently. Learning content is designed into small, concise chunks in various media formats, creating virtual representations of abstract concepts. This approach facilitates students' understanding of the material, accelerates information absorption, and enhances their cognitive abilities [13, 14].

Several studies have demonstrated the effectiveness of microlearning in the learning process. According to Mohammed et al. [15], the use of microlearning methods can improve students' learning abilities by up to 18% compared to conventional methods. Further findings indicate that microlearning also helps students retain knowledge for a longer period. Microlearning provides an advanced and practical solution to training and education challenges in the digital era [8]. Supporting research also shows that students' exposure to microlearning-based lessons significantly improves their academic performance in Chemistry [13]. However, despite the implementation of microlearning in various subjects, its application in teaching reaction rate material remains rare.

To effectively implement microlearning, selecting the right platform is crucial. The platform chosen for developing this microlearning system is Wix.com. This platform was selected based on evaluations from various sources, which rated it highly in terms of reliability, pricing, ease of use, support, and features [16]. Furthermore, teacher responses regarding Wix-based learning media indicate that this platform aligns with students' needs [17]. Other research findings also suggest that Wix has been tested from both developer and user perspectives, with results showing that its editing features provide a user-friendly interface. The ability to update content on each page easily enhances efficiency and effectiveness in content management [18]. This highlights the importance of an engaging learning environment, where students can initiate and manage their learning independently, allowing them to organize their time more effectively [6, 19].

2. Materials and Methods

The research method used in this study is the Research and Development (R&D) method. R&D aims to produce new products through a structured development process [20]. In this study, the product developed is a microlearning-based learning platform created using Wix, designed to teach the topic of reaction rate to Grade XI Senior High School students. The research and development process follows the ADDIE model, which includes five stages: Analyze, Design, Development, Implementation, and Evaluation. According to *Introduction to Microlearning*, the ADDIE model is the recommended framework for implementing microlearning strategies [21].

During the Analysis stage, a needs assessment was conducted by distributing questionnaires to both teachers and students. This assessment aimed to identify gaps in current instructional practices and evaluate the readiness of students and teachers for digital learning. The needs analysis instrument comprised 20 question items organized around key dimensions, including technology readiness (e.g., "I have a smartphone and stable internet access for online learning"), learning experiences in chemistry (e.g., "Are students able to learn independently using the teaching methods applied at school?"), and expectations for digital learning media (e.g., "What type of media format do you need if a microlearning platform is developed for the reaction rate topic?"). The responses from these questionnaires provided valuable insights into the feasibility and

Table 1. Likert scale rating.

Assessment Level	Score Weight
Strongly Agree (SA)	4
Agree (A)	3
Disagree (D)	2
Strongly Disagree (SD)	1

requirements for implementing the microlearning platform.

The Design stage of the study involved determining the material and microlearning content, creating a storyboard, selecting appropriate software (the Wix platform), and developing media feasibility instruments. In the Development stage, the microlearning website was created based on the established design and then validated by experts. Expert validation in this study focused on two main aspects: content and language validation, and media validation. The experts were purposively selected based on their qualifications and the relevance of their expertise to the educational innovation being developed. For content and language validation, two chemistry education lecturers—who possess strong expertise in chemistry subject matter and pedagogy—and one high school chemistry teacher—who offers practical classroom insights—were involved. For media validation, one ICT teacher assessed the technical aspects, usability, and clarity of the platform, while two chemistry education lecturers evaluated how well the digital media aligned with the principles of chemistry education.

In the Implementation stage, the validated product was tested through both small-scale and large-scale trials. Revisions were made after the small-scale trial before proceeding to the larger implementation. The small-scale trial was conducted over one day, involving a single class with two instructional periods. The large-scale trial also took place over one day and included two classes, each with two class periods. During these trials, students accessed the microlearning platform using their smartphones and interacted with the content provided. Afterward, they completed a trial instrument in the form of a student response questionnaire, which was designed to assess the broader feasibility of the microlearning platform.

Finally, the Evaluation stage consisted of both formative and summative evaluations. Formative evaluation was conducted throughout each stage of the ADDIE process to identify weaknesses and make necessary improvements before progressing to the next phase. Summative evaluation, on the other hand, was carried out at the end of the process to assess the final outcomes and effectiveness of the developed product.

The subjects of this study were 11th-grade students at SMA Negeri 102 Jakarta who had previously studied the topic of reaction rates. The small-scale trial was conducted in one class consisting of 20 students, while the large-scale trial involved two classes with a total of 73 students. The classes were selected purposively, based on their having completed the reaction rate topic and their readiness to engage in digital-based learning. This readiness was indicated by students' possession of devices such as smartphones, adequate internet access, and basic digital literacy skills.

The data collection technique in this study was carried out using questionnaires, which were utilized during the needs analysis, validation, and trial stages. First, the needs analysis instrument was used to gather information regarding the digital learning media required by students and teachers in schools. Second, the validation instrument was distributed to experts to assess the content, language, and media aspects of the developed microlearning. Third, the trial instrument was employed to evaluate students' and teachers' responses after using the microlearning platform. The questionnaire used was a non-test questionnaire based on a Likert scale with a 1-4 interval. The Likert scale was modified to address the weaknesses of the traditional five-point scale by removing the neutral middle option. There are two main reasons for this modification. The middle category is often included to provide a neutral option for respondents; however, in practice, respondents may choose this category when they do not wish to or are unable to provide an informative response. If response data is analyzed without considering these two possible uses of the middle category, the measurement can become ambiguous. As a result, the information obtained may be less than optimal [22]. To address this, a modified Likert scale was used in this study, as shown in Table 1.

In this study, the collected data were analyzed using a quantitative descriptive technique. The assessment data, which utilized a Likert scale, were analyzed by calculating the total score obtained from the questionnaire responses and determining the overall score. This process resulted in a feasibility percentage based on the Equation 1 [23].

$$Percentage\ (\%) = \frac{\sum \text{Obtained Score}}{\sum \text{Maximum Score}} \times 100\% \qquad (1)$$

The calculation results using the formula above were then interpreted based on the feasibility criteria presented in Table 2 [24].

Table 2. Interpretation of feasibility ratings.

Percentage Score	Interpretation
86% - 100%	Highly Feasible
71% - 85%	Feasible
41% - 55%	Not Feasible
< 40%	Highly Not Feasible

Table 3. Reliability criteria

Reliability Value	Interpretation
≤ 0.20	Poor
0.21-0.40	Below Average
0.41-0.60	Average
0.61-0.80	Good
0.81-1.00	Very Good

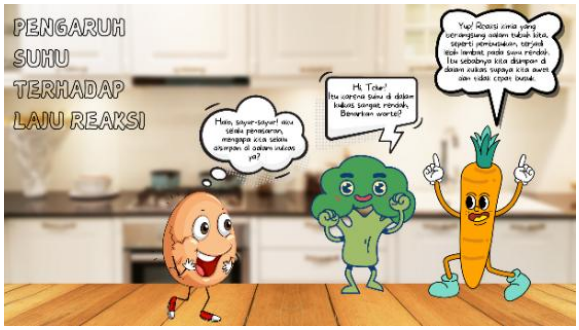

Figure 1. Chemistry comic illustrating the effect of temperature on reaction rate.

The collected data were analyzed for reliability to determine the level of consistency among experts in their assessments. The Hoyt formula (Equation 2) was used to calculate its reliability.

$$r = \frac{RJKb - RJKe}{RJKb} \quad (2)$$

Where r is the inter-expert reliability, $RJKb$ is the mean square between rows, and $RJKe$ is the mean square error.

The obtained data will be categorized based on the reliability criteria presented in Table 3. A study is considered successful if the interpreted reliability value falls within the range of 0.61 to 1.00, corresponding to the Good to Very Good categories [25].

3. Results and Discussion

The product resulting from this research is a microlearning titled "World of Chemistry," which focuses on reaction rate material and is developed using the Wix platform. This media can be accessed through https://bit.ly/worldchem_lajureaksi. The content presented on this website includes instructional videos, animations that support conceptual understanding, infographics, engaging chemistry comics, and interactive quizzes to assess students' comprehension. Figure 1 displays a snapshot from one of the chemistry comics illustrating the concept of temperature, where vegetable characters are discussing why vegetables are often stored in the fridge to maintain their freshness. This comic is designed to help students understand the effect of temperature on chemical reactions in a fun and easily comprehensible way.

3.1. Analysis of Students' Needs

The needs analysis was conducted by distributing questionnaires to 72 eleventh-grade students at SMA Negeri 102 Jakarta. The questionnaire consisted of 20 questions covering various aspects, including students' learning characteristics, learning media, teaching methods, learning facilities and infrastructure, and students' readiness to implement the developed product model. Based on the results, the primary difficulty students faced in learning reaction rate material was the complexity of the concepts. Musya'idah and Santoso [3], found that traditional learning often focuses only on the macroscopic and symbolic levels of chemistry, while the submicroscopic level is frequently overlooked. According to Chittleborough and Treagust in [26], the absence of submicroscopic-level representations in learning is one of the key factors preventing students from improving their representational skills and understanding chemistry concepts. Students also experienced difficulties due to the large amount of material they had to master. According to Milenković [27], cognitive load is most evident when students encounter complex material. This is referred to as intrinsic cognitive load, which arises from the complexity of the tasks or the large amount of material that students need to comprehend.

Moreover, most students reported that teachers tend to use the same learning media repeatedly. Data indicate that 76.1% of students felt they were not yet able to learn independently with the current chemistry teaching methods and required additional learning resources to support their self-directed learning. Therefore, the development of microlearning has the potential to help students overcome these challenges and facilitate their mastery of a broader range of learning materials. This can be achieved through a more straightforward and easily comprehensible approach, presenting content in various engaging and interactive media formats. Such an approach allows students to review the material more effectively and reduces their cognitive load.

3.2. Analysis of Teachers' Needs

The needs analysis was conducted by distributing questionnaires to three chemistry teachers at SMA Negeri 102 Jakarta. The questionnaire consisted of 20 questions covering various aspects, including student

Figure 2. Animation clip of effective collision.

characteristics, learning media, teaching methods, learning facilities and infrastructure, and teachers' readiness to implement the developed product model. After analyzing the teachers' responses, the researcher concluded that the teachers' observations aligned with the students' needs analysis in identifying the difficulties students face in mastering reaction rate material. These difficulties were primarily due to the complexity of the concepts, the large amount of material to be mastered, and the heavy reliance on memorization. According to Safitri [28], students struggle to connect multiple representations in chemistry, leading them to rely on rote memorization rather than meaningful learning. This challenge is further supported by research indicating that microlearning can improve students' learning patterns and retention, resulting in better educational outcomes [12].

The chemistry teachers reported using PowerPoint presentations, instructional videos, and physical teaching aids in their lessons. However, their use of online learning media remains limited, with YouTube being the primary digital resource. This finding indicates that the integration of other digital learning tools is still minimal. This aligns with research conducted by Hasanah et al. [5], which found that while technology has been incorporated into education, its implementation is still highly restricted, often serving only as a communication tool between educators and students, such as through WhatsApp, Zoom Meetings, and YouTube.

This is supported by data from the needs analysis, which indicates that teachers believe the current learning media do not fully meet the demands of education in the digital era. Additionally, teachers recognize that students require additional learning resources to support independent learning. Various media formats have been identified for integration into microlearning, including images, instructional videos, quizzes, animations, and interactive presentations. Furthermore, teachers at SMA Negeri 102 Jakarta already possess adequate technological devices and consider themselves proficient in their use. This suggests that teachers are well-prepared for the implementation of microlearning as part of the teaching and learning process.

Therefore, microlearning is expected to serve as a solution to the existing challenges. By utilizing microlearning, teachers can more effectively visualize concepts at the submicroscopic level. Figure 2 presents a snapshot from one of the instructional videos developed in the microlearning platform. The video visualizes particle interactions during effective collisions at the submicroscopic level, helping students grasp abstract concepts more clearly and concretely.

3.3. Theoretical Feasibility Assessment

The theoretical feasibility was determined based on validation results from experts in media, content, and language. These experts assessed the developed microlearning platform by completing a questionnaire containing statements regarding its feasibility. The content and language feasibility assessment aimed to evaluate the appropriateness of the material presentation and language usage. This assessment involved two experts from the Chemistry Education Study Program at Universitas Negeri Jakarta and one chemistry teacher from SMA Negeri 102 Jakarta. The evaluation results from the content and language experts are presented in Table 4.

Based on the average percentage of the feasibility test conducted by content and language experts, the developed microlearning media is deemed highly feasible in theoretical terms, achieving a score of 91.94% (SD = 0.49). The assessment results from content experts indicate that the developed media is suitable for trial implementation with students. Thus, it can be concluded that the content presented in the media is relevant, accurate, and aligned with the established learning objectives. Additionally, the material is presented effectively through various multimedia elements, including audio, video, illustrations, animations, factual content, and subject-specific terminology, enhancing the

Table 4. Feasibility test results by content and language experts.

Aspect	Question Items	Feasibility Percentage	Standard Deviation	Feasibility Criteria
Formulation of Learning Objectives	1	100%	0	Highly Feasible
Instructional Material	2, 3, 4, 5, 6, 7, 8, 9, 10	91.67%	0.47	Highly Feasible
Language Feasibility	11, 12, 13, 14, 15, 16	81.94%	0.45	Feasible
Microlearning Design	17, 18, 19, 20, 21, 22	94.44%	0.42	Highly Feasible
Cognitive Load	23, 24, 25	91.67%	0.47	Highly Feasible
Average		91.94%	0.49	Highly Feasible

Figure 3. Animated instructional video illustrating activation energy in a chemical reaction.

Table 5. Feasibility assessment by media experts.

Aspect	Question Items	Feasibility Percentage	Standard Deviation	Feasibility Criteria
Technical Format	1, 2, 3, 4, 5	96.67%	0.34	Highly Feasible
Visual Design	6, 7, 8, 9, 10, 11, 12, 13, 14	88.54%	0.58	Highly Feasible
Language and Communication	14, 15	79.17%	0.69	Feasible
Media Quality	16, 17,18, 19, 20, 21	97.22%	0.31	Highly Feasible
Average		90.40%	0.53	Highly Feasible

learning process in a more engaging and effective manner. To clarify how the concept of activation energy is presented in the microlearning media, Figure 3 displays an animated instructional video clip used to visualize activation energy in a chemical reaction. Following the feasibility test by content experts, a reliability test was conducted to assess the consistency of ratings among experts. The reliability score obtained was 0.97, categorized as Very Good.

In addition to the feasibility test conducted by content and language experts, a feasibility test was also carried out by media experts to evaluate the microlearning media in terms of product quality and multimedia design. This assessment involved two experts from the Chemistry Education Department at Universitas Negeri Jakarta and one ICT teacher from SMA Negeri 102 Jakarta. The evaluation results by media experts are presented in Table 5.

Based on the average percentage of the feasibility test by media experts, the developed product is considered highly feasible from a theoretical perspective, achieving a score of 90.40% (SD = 0.53). The evaluation results indicate that the developed product is suitable for student trials. Therefore, it can be concluded that the microlearning media possesses high product quality and well-designed multimedia elements. Following the feasibility test by media experts, the researcher conducted a reliability test to assess the consistency of expert ratings regarding the developed media. The obtained reliability score was 0.92, categorized as Very Good.

3.4. Empirical Feasibility Test Results

The validated microlearning was then tested at SMA Negeri 102 Jakarta to assess its empirical feasibility. The purpose of this empirical feasibility test was to evaluate the product's viability through field trials. The trial involved students and teachers as end users, with data collected through questionnaires. Both students and teachers assessed the microlearning media by responding to a set of statements in the questionnaire.

The small-scale trial was conducted with 20 students at SMA Negeri 102 Jakarta. Based on the questionnaire results, students gave positive responses to the developed microlearning platform. They stated that the visual design was appealing, the material was easy to understand, and the interactive features supported the learning process. No suggestions or

Table 6. Results of the small-scale student trial.

Aspect	Question Items	Feasibility Percentage	Standard Deviation	Feasibility Criteria
Technical Format	1, 2, 3, 4	88.75%	0.59	Highly Feasible
Media	5, 6, 7, 8, 9, 10, 11, 12, 13, 14	94.13%	0.43	Highly Feasible
Cognitive Load	15, 16, 17, 18, 19, 20, 21, 22, 23, 24	92.25%	0.47	Highly Feasible
Student Learning Motivation	25, 26, 27, 28, 29, 30	91.25%	0.51	Highly Feasible
Average		91.59%	0.49	Highly Feasible

Table 7. Results of the Large-Scale Student Trial.

Aspect	Question Items	Feasibility Percentage	Standard Deviation	Feasibility Criteria
Technical Format	1, 2, 3, 4	92.81%	0.47	Highly Feasible
Media	5, 6, 7, 8, 9, 10, 11, 12, 13, 14	94.18%	0.43	Highly Feasible
Cognitive Load	15, 16, 17, 18, 19, 20, 21, 22, 23, 24	93.01%	0.47	Highly Feasible
Student Learning Motivation	25, 26, 27, 28, 29, 30	93.38%	0.45	Highly Feasible
Average		93.34%	0.45	Highly Feasible

revisions were provided at this stage, but most students expressed hope that the platform would continue to be developed and utilized in future learning activities. Quantitative data from the small-scale trial questionnaire are presented in Table 6.

Based on the average percentage result of the small-scale trial conducted with students, the developed product was empirically categorized as highly feasible, obtaining a score of 91.59% (SD = 0.49). Therefore, no revisions or improvements were necessary, and the product was considered ready to proceed to the large-scale trial stage. The student feasibility assessment criteria encompass four aspects: technical format, media, cognitive load, and student learning motivation. First, the feasibility percentage obtained in the technical format aspect reached 92.81% (SD = 0.47), categorized as Highly Feasible. This indicates that all links, buttons, and navigation within the website function properly. The microlearning media was also deemed easy to operate without causing technical difficulties, thereby supporting a smooth learning process. Second, the feasibility percentage for the media aspect was 94.18% (SD = 0.43), also categorized as Highly Feasible. Overall, the highest percentage in the questionnaire, 96.23%, was obtained in the media aspect, specifically for the statement that students found infographics and instructional videos highly beneficial in facilitating their understanding of reaction rate concepts. This finding aligns with the study by Waruwu and Sitinjak [29], which found that the use of multimedia, such as infographics and videos, enhances learning effectiveness and improves concept comprehension by up to 15%. Additionally, Mewengkang et al. [30], stated that animated videos can significantly increase students' average learning outcomes in reaction rate topics.

A large-scale trial was conducted with eleventh-grade students at SMA Negeri 102 Jakarta who had previously studied the reaction rate topic. This stage involved 73 students as respondents. Data collection was carried out by distributing the website link to the microlearning media, which students could access using their smartphones. After using the media, students were asked to complete a Google Forms questionnaire to evaluate the developed microlearning media. The results of the large-scale trial conducted with students are presented in Table 7.

Third, the feasibility percentage obtained in the cognitive load aspect reached 93.01% (SD = 0.47), categorized as Highly Feasible. This result indicates that the developed microlearning media effectively reduces students' cognitive load. Within this aspect, the highest percentage was found in item 24, which scored 94.86%, demonstrating that students felt more engaged when learning with concise, simplified, and engaging materials. This finding aligns with the learning preferences of Generation Z, as described by Choudhary and Pandita [31]. This generation tends to have shorter attention spans and prefers microlearning content that is simple, goal-oriented, and engaging, which enhances student involvement in the learning process.

Fourth, the feasibility percentage obtained in the student learning motivation aspect reached 93.38% (SD = 0.45), also categorized as Highly Feasible. This result suggests that microlearning allows students to engage in self-directed learning and enhances their motivation through content presentation enriched with clear illustrations relevant to real-life contexts. This finding is consistent with a study conducted by Mohammed [15], which concluded that microlearning increases students' enthusiasm for learning and motivates them to expand their knowledge during the learning process.

Table 8. Feasibility Test Results by Teachers.

Aspect	Question Items	Feasibility Percentage	Standard Deviation	Feasibility Criteria
Instructional Materials	1, 2, 3, 4, 5, 6, 7, 8, 9	93.52%	0.44	Highly Feasible
Language Feasibility	10, 11, 12, 13	93.75%	0.43	Highly Feasible
Audio and Visual	14,15, 16, 17, 18, 19, 20, 21, 22	92.59%	0.46	Highly Feasible
Implementation Feasibility and Software Engineering	23, 24, 25, 26, 27	91.67%	0.47	Highly Feasible
Microlearning Design	28, 29, 30, 31, 32, 33	95.83%	0.37	Highly Feasible
Cognitive Load	34, 35, 36	91.67%	0.47	Highly Feasible
Average		93.23%	0.43	Highly Feasible

Based on the average feasibility percentage from the large-scale student trial, the developed microlearning media is empirically validated as Highly Feasible, achieving a score of 93.34% (SD = 0.45). These results indicate that the developed microlearning media meets feasibility criteria in terms of content, media, language, technical format, audio, visuals, implementation feasibility, and alignment with microlearning principles.

In addition to student trials, the microlearning media was also tested among chemistry teachers to assess their evaluations and perspectives on the developed product. This stage involved three chemistry teachers from SMA Negeri 102 Jakarta as respondents. The results of the teacher feasibility assessment are presented in Table 8.

The teacher feasibility assessment criteria encompass six aspects: Instructional Materials, Language Feasibility, Audio and Visual, Implementation Feasibility and Software Engineering, Microlearning Design, and Cognitive Load. First, the feasibility percentage obtained for the Instructional Materials aspect reached 93.52% (SD = 0.44), categorized as Highly Feasible. This indicates that the designed materials effectively support the learning process and contribute to achieving the intended learning objectives. Digital learning materials offer students greater flexibility to interact with the content, creating a more dynamic learning experience and enhancing their motivation. Successful initiatives, such as those implemented by Open University, demonstrate the significant potential of digital learning in improving educational outcomes [32]. Second, the feasibility percentage for the Language Feasibility aspect was 93.75% (SD = 0.43), also categorized as Highly Feasible. This demonstrates that the language used throughout the microlearning media adheres appropriately to standard Indonesian linguistic conventions.

Third, the feasibility percentage obtained for the Audio and Visual aspect reached 92.59% (SD = 0.46), categorized as Highly Feasible. Teachers provided highly positive feedback on this aspect, particularly regarding the design, color selection, animations, and clear audio quality that effectively supports the learning process. Based on this assessment, it can be concluded that the audio-visual aspects of microlearning provide an engaging learning experience for students. This data is supported by the findings of Gultom et al. [33], who stated that the use of audio-visual media can enhance students' learning outcomes, including their interest in learning, by providing a more engaging experience and motivating students to be more active in the learning process. The study found a positive and significant effect between the use of audio-visual media and students' learning interest. Fourth, the feasibility percentage obtained for the Implementation Feasibility and Software Engineering aspect was 91.67% (SD = 0.47), also categorized as Highly Feasible. This result indicates that microlearning is easy to use and practical in its implementation, with seamless functionality, making it highly feasible for learning applications Fifth, the feasibility percentage for the Microlearning Design aspect reached 95.83% (SD = 0.37), categorized as Highly Feasible. This finding suggests that the developed media fully adheres to microlearning principles. Research has shown that well-designed microlearning enhances student engagement and has a positive impact on learning outcomes. By breaking down learning materials into smaller, more manageable units, microlearning facilitates a more effective learning process and improves information retention [34]. Studies by Sathiyaseelan et al. [35], further confirm that the microlearning model significantly enhances students' knowledge retention compared to conventional learning methods.

Sixth, the feasibility percentage for the Cognitive Load aspect was 91.67% (SD = 0.47), categorized as Highly Feasible. This result indicates that the microlearning media were designed to be concise, simple, engaging, and easy to understand, enabling students to take control of their learning activities. This approach aims to reduce students' cognitive load while processing the subject matter. An effective instructional design must balance cognitive load by providing sufficient Intrinsic Cognitive Load (ICL), minimizing unnecessary distractions or Extraneous Cognitive Load (ECL), and enhancing Germane Cognitive Load (GCL), which facilitates deeper information processing [36]. Based on the average

Figure 4. Interactive Wordwall game on factors affecting reaction rate.

feasibility percentage obtained from chemistry teachers, the developed product is empirically categorized as Highly Feasible, achieving a score of 93.23% (SD = 0.43). These results indicate that the microlearning media is highly suitable in terms of content, language, audio and visual aspects, implementation feasibility, microlearning design, and cognitive load, making it a valuable supplementary learning resource. However, teachers also provided constructive feedback suggesting that the media should include more practice questions. This aims to give students more opportunities to independently test their understanding. In response to this suggestion, the researcher has followed up by adding quiz features and practice questions to the microlearning platform as an effort to strengthen the evaluation aspect of the learning process.

3.5. Discussion

During the trial phase, students responded positively to the developed microlearning. They stated that the platform featured an engaging design and was equipped with various elements, such as infographics, videos, and quizzes. In terms of content, the microlearning approach was perceived as effective in enhancing students' learning enthusiasm due to its simple, structured, and segmented presentation, which made the material easier to comprehend. The inclusion of interactive games and diverse quizzes provided an engaging learning experience, facilitated quick review sessions, and trained students to solve problems efficiently. These features increased students' motivation to complete the quizzes and games. One example is shown in Figure 4, which displays an interactive Wordwall game on the factors affecting reaction rate.

Students' assessments align with research conducted by Mohammed [15], which found that utilizing microlearning in the form of infographics can be more effective in delivering information and improving students' long-term memory retention. This finding is further supported by Peters [37], who suggested that presenting information through short video segments allows the brain to pause and process information more effectively, thereby preventing cognitive overload. Additionally, the study indicated that shorter video durations correspond to higher levels of student engagement and attention in instructional videos.

Although the results of this study indicate that the developed microlearning media received positive responses and was deemed feasible for use, several limitations were encountered. These include time and budget constraints during the development process. Creating high-quality content, such as animated videos and infographics, required substantial resources. In addition, only free features of platforms like Wix, Quizizz, and Wordwall were used, which limited the scope of content development. Another limitation was the short duration of the trial phase, which prevented long-term implementation. Analytics from the platform were also not fully utilized due to the limited student access period. In addition, this study was conducted only with students and teachers in Jakarta, so the results cannot yet be directly generalized to broader educational contexts. Future research should explore the implementation of similar microlearning platforms in diverse educational settings, such as schools in rural areas or with varying levels of technological infrastructure, to evaluate whether similar outcomes can be achieved. These limitations highlight important considerations for further development and evaluation to ensure optimal implementation of microlearning media across different educational contexts.

4. Conclusions

The development of Wix-based microlearning on the topic of reaction rates for Grade XI Senior High School, designed using the ADDIE development model, has successfully met the needs of both students and teachers as an interactive supplementary learning resource. This

microlearning integrates various media formats, including infographics, videos, quizzes, games, and PDFs, aimed at enhancing students' understanding while facilitating the visualization of abstract concepts that are often difficult to grasp in reaction rate topics. The platform offers flexibility as it can be accessed anytime and anywhere at https://bit.ly/worldchem_lajureaksi.

Based on theoretical feasibility tests, validation by subject matter and language experts resulted in a feasibility percentage of 91.94%, categorized as highly feasible. Validation by media experts yielded a feasibility percentage of 90.40%, also classified as highly feasible. Empirically, the feasibility test results showed a feasibility percentage of 91.59% in the small-scale student trial, categorized as highly feasible. In the large-scale student trial, a feasibility percentage of 93.25% was obtained, and the chemistry teachers' evaluation resulted in a feasibility percentage of 93.23%, both categorized as highly feasible. Therefore, the Wix-based microlearning on reaction rates is deemed highly feasible both theoretically and empirically as a supplementary teaching material in the learning process.

Nevertheless, this study has limitations, such as its scope being limited to students and teachers in the Jakarta area, and the lack of implementation to test the effectiveness of using the Wix-based microlearning platform in improving student learning outcomes in the topic of reaction rates. For practical implementation, teachers need to have basic skills in using digital platforms, a stable internet connection, and sufficient preparation time to adapt the material according to their teaching context. While this microlearning approach can be an engaging alternative for learning, it requires technical training for teachers and the readiness of students' devices.

Future research is expected to implement this microlearning platform on a larger scale and develop similar learning media for other chemistry topics. Considering that the microlearning approach aligns well with the learning preferences of Generation Z students, who tend to favor technology-based learning and concise content, this study opens up opportunities for broader application in various educational levels.

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Data Availability Statement: The data supporting this study's findings are available from the corresponding author upon reasonable request.

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