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Implementation of Wordwall Media on Students' Motivation and Chemistry Learning Outcomes in the Colligative Properties of Solutions Topic

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Abstract

Student learning motivation in chemistry is often low due to passive and less engaging learning methods, so interactive learning media are needed that can increase engagement and learning outcomes. This study aims to examine the effect of using gamification-based learning media, Wordwall, on student motivation and learning outcomes in the colligative properties of solutions. The study used a quantitative descriptive method with a sample of 35 students of class XII Sainkes 4 SMAN X Bogor Regency. Motivation was measured using a Likert scale questionnaire with six indicators, while learning outcomes were obtained from Mid-Semester Assessment scores and essay assignments. The results showed that the average student learning motivation reached 71% (good category) and the average learning outcome score was 87.2, with female students' motivation and learning outcomes slightly higher than male students, although the difference was not significant. These findings indicate that Wordwall has the potential to increase student engagement and motivation, although the descriptive design of the study does not allow for direct causal conclusions. The practical implication of this study is that the use of Wordwall as an interactive learning strategy can help teachers create more engaging, relevant, and participatory learning experiences in chemistry classes. This research is academically relevant because it highlights the understudied use of gamification-based digital media in the context of chemistry motivation and learning outcomes. The results also open up further research directions with experimental designs, larger samples, and the testing of additional factors such as digital self-efficacy or comparisons of various digital media to strengthen empirical evidence of the influence of interactive media on motivation and learning outcomes.

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1. Introduction

Education is one of the key variables determining the future of a nation. Education also influences students' ability to adapt to their environment (Pamungkas dkk., 2023). According to Article 28C paragraph 1 of the 1945 Constitution, "Everyone has the right to develop themselves through the fulfillment of their basic needs, the right to education, and to benefit from knowledge," and Article 31 paragraph 1 of the 1945 Constitution states that "Every citizen has the right to education." Thus, all Indonesian citizens have the right to education (Paulus dkk., 2023). Education is defined as an effort aimed at changing human behavior in positive and desirable ways. Education enhances a person's creativity, preparing them to face the challenges of nature, society, technology, and a more diverse life (Nurmelati, 2022). Quality education is an essential foundation for developing effective learning strategies, including in science learning.

Chemistry subjects in high school (SMA) or Islamic high school (MA) cover all aspects of matter, including composition, structure and properties, change, dynamics, and energy, as well as skills and reasoning (Novalia dkk., 2015). Everything in chemistry is used to explain various natural phenomena that occur in life, requiring skill and logic to derive explanations because most chemical concepts are inherently abstract. Therefore, strong focus is crucial for a thorough understanding of the concepts and principles of chemistry lessons, which are still contextually abstract (Tajadi, 2023). Factors influencing students' learning difficulties in chemistry include physiological factors, facilities and infrastructure, learning methods, and teachers (Ristiyani & Bahriah, 2016). Consequently, high school students' perceptions of chemistry as a difficult subject can dampen their enthusiasm or willingness to learn. This situation indicates the absence of significant challenges in chemistry learning that need to be addressed through innovative learning media.

Students' ability to comprehend information presented by teachers is significantly influenced by the teaching and learning process. Therefore, it is crucial for educators to use resources that engage students, such as chemistry lessons (Sariati dkk., 2020). They experience difficulty mastering chemistry lessons, resulting in students' lack of engagement in class. Consequently, student interest in learning chemistry is low. This occurs due to passive and uninnovative learning. Students' interest in learning will continue to decline if the learning methods or content are static or boring. Therefore, the teaching and learning process in the classroom must be modified or updated (Saputra, 2019). Learning tools designed and used by teachers to help present material in class are called learning media (Nurrita, 2018). Teachers can also use learning media as a creative platform to develop various learning processes and tactics. The use of innovative teaching resources can increase students' desire to learn, increase their enjoyment and interest

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in the subject, and even have psychological consequences for them (Paulus dkk., 2023). Therefore, selecting appropriate learning media is important to support motivation and understanding of chemical concepts.

The education sector is unavoidably impacted by the rapid advancement of information technology in today's era of globalization. The education sector must continually adapt to technological advances in an effort to improve the quality of education, particularly in the learning process, in response to global demands (Nurmelati, 2022). Developing educational games is one way to utilize technology in the classroom. Education is no longer limited to paper textbooks but has entered the digital realm through blogs and websites accessible via laptops and mobile phones. Therefore, it is not surprising that students now consider the internet essential. Schools and universities both at home and abroad frequently utilize the internet and web-based learning (Paulus dkk., 2023). The shift to digital learning opens up opportunities for the application of interactive media to increase learning motivation, which is the basis for this research.

Interactive games have multiple players and are designed to enhance brain activity. Brain performance is linked to the discovery, production, and distribution of engaging, agile, and educational information (Sudarsono, 2021). Wordwall is online software used as a game-based learning tool for word games, quizzes, and other activities. Wordwall provides templates of various types and models. Games can be developed on request. These templates include photo guessing games, quizzes, puzzles, and more (Destiana & Purwanto, 2024). Menurut Yuniar dkk. (2021) these games are used in puzzle and quiz formats. The Wordwall web application is an interactive learning tool in the form of a game that can be easily accessed online through wordwall.net and has an attractive and diverse appearance, which is then responded to by students. Students can use the Wordwall web application independently or with teacher assistance. The Wordwall web software provides online learning assessment tools. This application is expected to help students better understand online learning materials and thus improve their learning (Rahmah dkk., 2023). The use of Wordwall is important to research because it can be an innovative learning medium that combines gamification and digital learning, thereby increasing student motivation and participation.

The shift in learning towards the digital realm also reinforces the need for interactive media that aligns with the demands of 21st-century learning. The significant increase in the use of educational technology indicates that digital platforms are becoming an integral part of today's learning experiences (Putri & Yuliana, 2022). This situation is relevant to the problem of low motivation to learn chemistry, which still frequently occurs in science learning (Maulidina dkk., 2023).

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Furthermore, the trend of gamification in education has been shown to increase student engagement, interest, and participation. Empirical studies show that the integration of game elements can create a fun and effective learning environment (Hamari et al., 2014), making the use of Wordwalls increasingly in line with the need for innovative learning that encourages student motivation and understanding. This indicates a research gap, as there are not many studies that specifically examine the effect of Wordwalls on motivation to learn chemistry in the classroom.

Based on survey data from approximately one month of chemistry class learning, it appears that student learning motivation remains low. Furthermore, it is known that the low quality of chemistry learning stems from: 1) a lack of effectiveness in the learning process. In the learning process, teachers tend to be lecturers and provide few opportunities for students to improve their abilities, resulting in boredom and low student learning motivation; 2) The learning methods used are ineffective and not tailored to class needs, but rather focused on material demands. The material demands in question are that every basic potential can be completed immediately according to the time available in the academic calendar without considering student capacity and abilities; and 3) Students are less focused during lessons and engage in more non-learning activities such as making noise, chatting, fanning themselves, and talking with their deskmates. This creates a research gap because there has not been a specific implementation of gamification-based interactive media to systematically increase motivation to learn chemistry in the classroom. To address this, it is crucial to create a chemistry lesson plan to discover and apply chemical concepts. Wordwall games are one type of learning media that can be used to increase student motivation and learning outcomes. The purpose of this study was to examine the effect of implementing a wordwall on student learning motivation in chemistry. Therefore, the implementation of wordwall media in chemistry learning is necessary.

2. Materials and Methods

This study employed a quantitative descriptive method, which analyzes data by describing the collected data without the intention of making generalizations (Sugiyono, 2022). The study aimed to examine the effect of using Wordwall as a learning medium on student motivation and learning outcomes in chemistry. The study was conducted in the odd semester of the 2024-2025 academic year at SMAN X Bogor Regency. The study population was all 12th-grade students of the Health Sciences (Sainkes) program, while the sample size was 34 students from 12th-grade students of Sainkes 4.

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The main instrument was a learning motivation questionnaire administered online via Google Forms (https://forms.gle/ZEuGnLr3U4hurh6t7). The questionnaire consisted of 30 questions divided into six indicators. The following is the outline of the learning motivation questionnaire:

Table 1. Kisi-Kisi Kuesioner Motivasi Belajar

No	Indikator Motivasi Belajar	Nomor Soal	Jumlah Soal
1.	Adanya Hasrat dan keinginan berhasil	1,2,3,4, dan 5	5
2.	Adanya dorongan dan kebutuhan dalam belajar	6,7,8,9, dan 10	5
3.	Adanya harapan dan cita-cita masa depan	11,12,13,14, dan 15	5
4.	Adanya penghargaan dalam belajar	16,17,18,19, dan 20	5
5.	Adanya kegiatan yang menarik dalam belajar	21,22,23,24, dan 25	5
6.	Adanya situasi belajar yang kondusif	26,27,28,29, dan 30	5

Kuesioner ini dirancang dengan menggunakan sistem penilaian skala Likert yang terdiri dari 4 pilihan jawaban. Kuesioner motivasi belajar memberikan pilihan jawaban sebagai berikut:

Table 2. Skor Penilaian Skala Likert

Skor	Keterangan
1	Sangat Tidak Setuju
2	Tidak Setuju
3	Setuju
4	Sangat Setuju

Wordwall is used in the form of interactive games such as quizzes, word charades and puzzles, with students accessing online applications via wordwall.net (D. A. Sari dkk., 2020). Each learning session lasts 2 x 45 minutes for 4 consecutive meetings. Teachers guide students in using Wordwall, while students can also access the app independently at home for additional practice. Wordwall is used as an innovative learning media that combines gamification and digital learning to increase student motivation and engagement.

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Student learning outcomes are obtained from Mid-Semester Assessment (PSTS) scores and essay assignments, while motivation data is analyzed based on questionnaire scores. The formula for calculating the percentage of motivation categories is:

$$P_k = \frac{s}{N} \times 100\%$$

Keterangan:

P_k = Nilai Kategori kelayakan

s = Jumlah skor butir yang diperoleh

N = Jumlah skor butir soal ideal

Menurut klasifikasi motivasi belajar dari Arikunto (2016), yang ditampilkan pada Tabel 3 di bawah ini, motivasi belajar siswa dibagi menjadi lima kategori berdasarkan hasil pengolahan data yang telah dilakukan.

Table 3. Kategori Motivasi Belajar Peserta Didik

No	Rentang Persentase Motivasi belajar	Kategori
1.	80 ≤ P ≤ 10	Sangat Baik
2.	65 ≤ P ≤ 79,99	Baik
3.	55 ≤ P ≤ 64,99	Cukup
4.	40 ≤ P ≤ 54,99	Kurang
5.	0 ≤ P ≤ 39,99	Sangat Kurang

Data analysis was conducted using quantitative descriptive methods, including calculating mean motivation scores, motivation categories, and average student learning outcomes. This analysis aimed to systematically illustrate the extent to which Wordwall influenced student motivation and learning outcomes.

3. Results and Discussions

This research was conducted at SMAN X in Bogor Regency. After the teacher explained the lesson material, students were asked to complete practice questions using *Wordwall*. *Wordwall* is an application used to create learning media such as quizzes. It can be developed as a game- based gamification tool designed like playing a game. The presence of *Wordwall* can be used to

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create educational games packaged in interesting quizzes (Y. Sari et all., 2024). The use of *Wordwall* helps students feel more comfortable with the content they are learning or reviewing, making the classroom less monotonous and more enjoyable for both students and teachers (Aprilia et all., 2023). Quizzes, matching, pairing, anagrams, random word puzzles, word searches, grouping, and other learning resources are included in the *Wordwall* application (Layyinnati., 2022).

A total of 35 students from class XII Science 4 at SMAN X in Bogor Regency participated in this research as respondents. A questionnaire was used to collect information about the students' motivation in learning colligative properties of solutions. According to Uno (2016) the learning motivation questionnaire includes six indicators:

1. The existence of a desire and drive to succeed.
2. The existence of needs and drives in learning.
3. The existence of hopes and aspirations for the future;
4. The existence of rewards in learning.
5. The existence of engaging activities in learning.
6. The existence of a conducive learning environment.

This study used primary data consisting of questionnaire items in the form of a Likert scale. The results of the students' learning motivation questionnaire as a whole can be seen in Table 4 below.

Table 4. Overall Students' Learning Motivation Results

Description	Value
Number of Samples	35
Highest Score	90.83
Lowest Score	34
Average Score	71

Based on the results of the questionnaire, the learning motivation of class XII Science 4 students reached a percentage of 71%, which falls into the "good" category. These findings indicate that the implementation of the *Wordwall* method has increased students' motivation in learning chemistry. The high level of student motivation is evidence that the effort to enhance motivation has been successful. This was demonstrated when students used the *Wordwall*

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educational game for learning, where most of them appeared highly interested and actively participated in answering questions within *Wordwall*.

Aguilera & Mendiz (2003) stated that the benefits of integrating games into learning activities are undeniable. In this case, games can increase perception and stimulation, train skills, provide motivation, and help players become more skilled in problem-solving (S. R. Lestari et all., 2023). Students who participated in learning activities experienced enjoyment, which indicated that they engaged in the process voluntarily and without coercion (Azza et all., 2023). The findings of this research are consistent with Agustina et all. (2024) those who found that using *Wordwall* and *discovery learning* had a positive impact on students' learning motivation. Furthermore, other studies have shown that the use of the *Wordwall* application can improve high school students' learning motivation in physics (Utami *et al*., 2023).

The results of students' learning motivation for each indicator in learning colligative properties of solutions using *Wordwall* learning media are presented in the following figure.

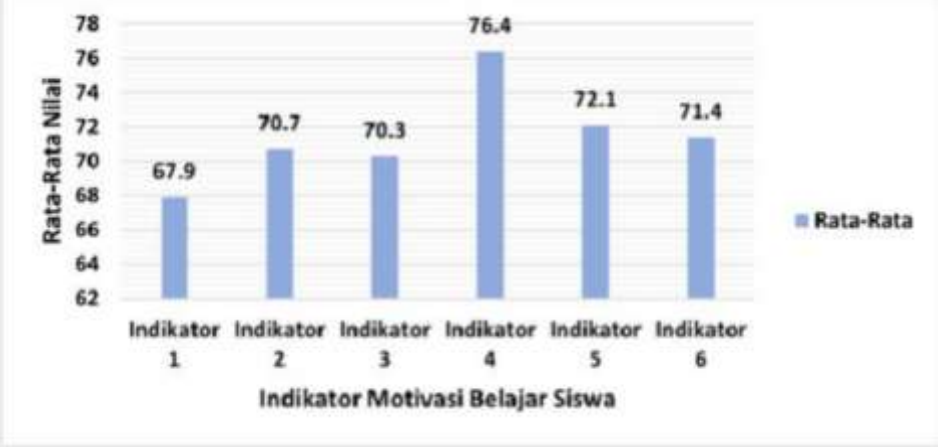

Figure 1. Students' Learning Motivation Results for Each Indicator

Description:

1) Indicator 1: Existence of desire and drive to succeed
2) Indicator 2: Existence of needs and drives in learning
3) Indicator 3: Existence of hopes and aspirations for the future
4) Indicator 4: Existence of rewards in learning
5) Indicator 5: Existence of engaging activities in learning
6) Indicator 6: Existence of a conducive learning environment

Based on Figure 1, the average score for all indicators of learning motivation ranged between 67.9 and 76.4. The first indicator, the existence of desire and drive to succeed, had an

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average score of 67.9, which is categorised as good. This was evident when the teacher explained the topic and steps for using *Wordwall* in practice exercises, as several students appeared enthusiastic and encouraged each other. According to Uno (2016) the drive to succeed in learning is sometimes referred to as achievement motivation, which aims for success in completing tasks or assignments. Students with strong achievement motivation usually complete tasks on time and do not procrastinate. This intrinsic motivation refers to willingness, needs, desires, and internal obligations to act in certain ways (Tampubolon, 2016). According to Hamdu & Agustina (2011), students' success in learning is greatly influenced by motivation to achieve a goal. Students who are driven to succeed will be more likely to learn, which will enable them to achieve the desired success (Haster et all., 2019). The factor that influences students' desire to consistently achieve in learning is the existence of passion and the desire to succeed. Thus, students will strive hard to learn without external pressure because they want to succeed from within themselves (Rahiem, 2021).

The second indicator is the existence of the need and drive to learn, which has an average score of 70.7, included in the good category. Some students used Wordwall media to complete their projects with discipline and diligence. This shows that students are highly motivated to learn. According to Aspian (2018), students' motivation and needs determine how much they learn, and those who view learning as important will be more driven to study (Eriany et all., 2014). According to Uno (2016) the drive to succeed is not always the driving force behind completing tasks. Sometimes avoiding failure actually encourages someone to complete tasks. Students carefully complete their assignments because otherwise, they will get bad grades from teachers, ridicule from peers, and possibly scolding from parents. This is included in the category of achievement motivation, namely the motive to avoid failure (Bauzir & Zulfiana, 2021). The purpose of the motive to avoid failure is to prevent and predict negative outcomes of failure, such as shame, loss of status, or decreased self-confidence (Capa et all., 2008).

The third indicator is the presence of hopes or aspirations for the future, which has an average score of 70.3, placing it in the good category. According to Hamdu & Agustina (2011), the presence of hopes or aspirations is an intrinsic motivation, which is the drive to learn something in order to fulfill one’s dreams that will increase as a person recognizes and understands the goals to be achieved. According to Widlund et all. (2020), aspirations are something that motivates students to participate more actively in the learning process. Students will be more motivated to do everything that can improve their learning quality, such as actively completing assignments, improving their performance in learning, and seriously participating in

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the learning process, if they have hopes and aspirations they want to realize in the future (Rahiem, 2021). Students will work hard and complete all assignments from the teacher if they want to get high grades or rankings in class (Uno, 2016).

The fourth indicator is the presence of rewards in learning, which has an average score of 76.4, placing it in the good category. This shows that students enjoy using Wordwall media to learn about the collaborative quality of solutions. Verbal rewards, such as praise or other gifts for good behavior and good learning outcomes, are simple and efficient techniques to increase students' learning motivation (Uno, 2016). In addition to satisfying students, statements such as "good," "great," and others convey the importance of individual interaction and experience between students and teachers. These statements also provide specific communication, which can lead to social recognition, especially when expressed in front of many people (Uruk, 2021). This is beneficial because it can foster initiative and creativity (Hidayat, 2015), as well as increase students' motivation (Manzilatusifa, 2007).

Based on the research results, the fifth indicator, which is the presence of interesting activities in learning, has an average score of 72.4, thus falling into the good category. This is shown by the enthusiasm and involvement of students in using Wordwall media on the topic of colligative properties of solutions. Interesting learning activities help students stay motivated to learn by preventing them from quickly feeling bored with the lessons (Ginting & Amir, 2012). Games and simulations are one of the interesting learning methods (Uno, 2016). An engaging environment makes learning relevant, thus becoming something that will always be remembered and understood. Students can become engaged in class by being inspired and motivated to learn through interesting activities. According to Maghfirohm (2018) research, media can stimulate learning activities and increase the desire to learn, preventing students from losing interest while working toward their learning goals. Wordwall is the media used in this research to teach the colligative properties of solutions.

The last indicator is the presence of a conducive learning environment, which falls into the good category because its average score is 71.4. This shows how students can learn effectively and efficiently when Wordwall media is used in the learning process. A conducive learning environment, according to Uno (2016) is everything related to the location where the learning process takes place that supports and facilitates the continuity of the learning process. A conducive learning environment, such as a neat, clean, peaceful, and pleasant classroom, can help motivate students to learn and maintain their focus (Sidik & Sobandi, 2018). According to

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Elvinawati et all. (2012), the presence of a conducive learning environment is expected to motivate students to learn so that they can achieve good learning outcomes.

The results of the study show that each indicator of students' learning motivation in learning the colligative properties of solutions through Wordwall media falls into the good category. This is in line with the research of Natasha et all. (2024), which found that Wordwall media can increase students' learning motivation and academic achievement. In addition, other studies also show that Wordwall can help teachers present science content in a more interesting way and increase students' motivation and engagement in the learning process (R. Lestari & Rohmani, 2024). One definition of learning motivation is the drive a person has to complete learning tasks (Bate'e, 2015). A student who consistently shows high learning motivation will actively participate in learning activities (Cahyono et all., 2022). According to Dimiyati & Mudjiono (2009), motivation is very important in learning because it clarifies goals, processes, and learning outcomes, informs about learning strengths, guides learning activities, increases enthusiasm for learning, and recognizes the existence of the learning journey and ease of continuous learning. The data on students' learning motivation is reinforced by their learning outcome scores shown in Table 5.

Table 5. Students' Learning Outcomes

Description	Value
Number of Samples	35
Highest Score	96.3
Lowest Score	71.3
Average Score	87.2

The average score of students' learning outcomes, as shown in Table 5, is 87.2. Learning outcomes are the abilities acquired by students after receiving instruction from teachers or other educators. The affective, cognitive, and psychomotor domains are some of the experiences gained by students (Hutapea, 2019). The learning outcomes achieved by students reflect one of the learning objectives. High-achieving students show that they have mastered many things. Motivation is one of the elements that influences how well students learn (Rahman, 2022).

High learning outcomes were obtained from the learning of colligative properties of solutions using Wordwall media. This is because the results of students' learning motivation fall into the good category. According to Romandhon (2013) his is indeed true; students who have high motivation are more likely to achieve high learning outcomes, because motivation is very necessary during the teaching process. The more motivated students are, the more intensely

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they will work to achieve their learning goals. According to other research, if students are motivated to learn, the learning process will be successful (Arianti, 2019). Fun learning implementation will provide comfort and enjoyment to students, helping them achieve optimal learning success (Pangestika et all., 2017). Teachers must use creativity to inspire students to learn in order to achieve the best learning outcomes (D. A. Sari et all., 2020). One of these ways is through Wordwall media. Lessons will be more successful if students are motivated in ways that are acceptable to them. In other words, individuals who strive hard and are highly motivated will be able to achieve good learning outcomes. When related to gender, the following results of students' learning motivation are obtained:

Table 6. Students' Learning Motivation Based on Gender

Gender	Male	Female
Number of Students	9	26
Highest Score	82	91
Lowest Score	58	34
Average	70	72
Category	Good	Good

Based on Table 6, the learning motivation scores for male and female students are 70 and 72, respectively, and do not differ significantly. This shows that the motivation to understand the colligative properties of solutions using Wordwall media falls into the good category for both male and female students. Female students' learning motivation is significantly higher on average than that of male students. This is consistent with research showing that female students are generally more motivated to learn than male students (Santana et all., 2017). In addition, Vecchione et all. (2014) found that although external regulation tends to be higher among males, females have higher intrinsic motivation at all educational levels. This is due to behavioral differences, which are one of the reasons why female students are more motivated to learn than male students (Malini & Fridari, 2019)

5. Conclusions

This study aimed to examine the effect of using Wordwall as a learning medium on student motivation and learning outcomes in chemistry. The results showed that the average student motivation increased to 71% (good category), while the average learning outcome score reached
87.2. These findings suggest that implementing Wordwall has the potential to increase student

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motivation and engagement in chemistry learning. Higher motivation and learning outcomes were also observed in female students compared to male students, although the differences were not significant.

Limitations of this study include the limited sample size, short treatment duration, and descriptive design that does not allow for causal conclusions. Practically, the findings suggest that Wordwall can be used as an interactive, gamification-based learning medium to increase student engagement, motivation, and participation in chemistry classes. Teachers can utilize Wordwall to make the learning process more engaging, interactive, and relevant to the demands of 21st-century learning. For future research, it is recommended to use an experimental design with a larger sample size, as well as examine additional factors such as digital self-efficacy or compare various digital media. These findings confirm the potential of Wordwall as an innovative learning strategy and open up further research directions to strengthen empirical evidence regarding the influence of interactive media on student motivation and learning outcomes.

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