Chemistry Learning Using *Red and Ox Game* As Learning Media During Covid-19 Pandemy

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Abstract. *This research aims to determine the effect of the use of redand Ox games through online learning during Covid-19 pandemic seen from the learning outcomes of students as well as students' responses. In this study using a one group pretest-posttest research design, where participants will be given a pretest before using the game and posttest thereafter. The game was tested on 28 students at public senior high school 2 Ngawi. The results showed that the learning outcomes of students after using The Red and Ox game had increased with classical completeness reaching 85.7%. The score obtained by students when doing a pretest is 23.9 and posttest is 80.8 so it shows an increase that is tested with an N-gain score of 0.7 which is in the medium category. In addition, the response of students after using Redand Ox game was 87.88%, indicating that Red and Ox game can be used as instructional alternatives in chemistry learning.*

Keywords: chemical learning, red and ox game, corona pandemy.

INTRODUCTIONS

In this century, rapid progress is evident in education and learning. The rapid development of information technology has also contributed to the advancement of education and knowledge, making them more meaningful. Therefore, learning is continuously required to undergo renewal in order to achieve ideal outcomes. The steps that must be taken to obtain perfect education include the need for curriculum improvements [1]. As stated by the Ministry of Education and Culture, the School-Based Curriculum (KTSP) was changed to the revised 2013 Curriculum, which has been gradually implemented in schools. The 2013 Curriculum is the foundation of teaching, consisting of four measurement factors: knowledge, skills, social, and spirituality. The 2013 Curriculum is a character- and competence-based curriculum [2].

The chemistry teacher at Senior High School 2 Ngawi revealed that at the secondary school level, chemistry is still considered difficult by some students due to its relation to the structure of matter and the complex concepts contained within the subject of chemistry [3]. Based on the theories studied in the redox material, there are a few unique aspects, including the relationship between concepts and simple mathematical calculations. The relationship between concepts may refer to the sequence of redox theory and previous theories [4]. This becomes one of the reasons for the difficulty of redox material.

Another reason, as stated by the chemistry teacher at Senior High School 2 Ngawi, is that chemistry contains material that is difficult for some students to imagine [5]. The difficulty in students understanding chemistry is caused by the fact that teaching in schools still relies on textbooks that only present written content. Meanwhile, students today are reluctant to read books for extended periods due to easily becoming bored [6]. Ni Ketut [7] also argued that the absence of examples of redox reactions in daily life, which could help students understand the micro processes in electrochemical cells, is one of the factors influencing the low levels of mastery and learning outcomes. Furthermore, the redox concept material involves many problems based on the micro processes in Volta cells and electrolytic cells, making it difficult for students to comprehend. In addition to the

difficulty of the material itself, the COVID-19 pandemic, which entered Indonesia in early March, has affected the teaching and learning process at both the school and university levels [8].

To reduce the number of COVID-19 cases, the provincial and local governments took educational policy measures by temporarily halting face-to-face learning and replacing it with online learning, both at the school and university levels [9]. Based on an interview with the chemistry teacher at Senior High School 2 Ngawi, difficulties in understanding redox material became one of the challenges, which were further intensified by the burden on educators to explain the topic in a way that is easy to understand. Moreover, with the pandemic forcing students to learn from home, teachers faced difficulties in selecting the appropriate methods to deliver the material effectively, so that students could better understand it.

Due to the difficulties faced by students, there is a need for appropriate and engaging learning media. Lutfi [10] states that game-based media can create a pleasant learning atmosphere, making students feel happier. Sudjana & Rivai [11] argue that learning media can enhance the effectiveness of students' learning methods, which in turn influences the improvement of their learning outcomes. There are several reasons why learning media can improve learning methods. These media can capture students' attention, which ultimately sparks their enthusiasm for learning and encourages them to be more active in learning activities, such as observing, performing actions, or demonstrating, rather than simply listening to the teacher's explanation.

In its development, learning media has kept pace with technological advancements. Technological progress has increasingly driven innovative efforts in utilizing it for student learning. One of the steps in the education program is the effective use of technology-based learning media when teachers deliver lessons. The use of appropriate media can facilitate students in understanding the material being taught [12]. A type of learning media that can be used in delivering redox material is games.

The Red and Ox game can be used as a learning media [3]. This game is adapted from the Super Mario game, where the player acts as Red, who needs help to find an ancient artifact located in a secret dimension. To reach this dimension, the player must overcome various obstacles [3]. These obstacles contain questions that the player must answer. The questions are based on KD 3.3, which involves balancing redox chemical reactions and predicting reactions that can occur based on electrode potentials. The use of the Redox game as a learning media is expected to assist students in understanding redox material during the COVID-19 pandemic through online learning, particularly for students in class XII MIPA 3 at Senior High School 2 Ngawi. Based on the above description, this study aims to determine the effect of using *The Red and Ox* game on redox material through online learning during the COVID-19 pandemic, as seen from the improvement in students' learning outcomes and students' responses.

METHODS

This study employs the One-Group Pretest-Posttest Design. The research subjects are 28 students from class XII MIPA 3 at Senior High School 2 Ngawi. A pretest consisting of 16 multiple-choice questions was given before the students used *The Red and Ox* game. After the learning session using *The Red and Ox* game, the students were given a posttest. Both the pretest and posttest were administered online via Google Forms. The difference in the average scores of the pretest and posttest was analyzed first using a normality test to check whether the data followed a normal distribution. Subsequently, a paired t-test was performed, followed by the calculation of the normalized gain score. The normality test, paired t-test, and gain score calculations were supported by the SPSS Statistics Program Version 22.

Students' responses are useful for understanding their feedback during the use of the game media, and this data also serves as supplementary information for assessing students' learning outcomes. The method used to gather responses was through a questionnaire containing 8 statements, where students were asked to select "Yes" or "No" answers, which were administered online via Google Forms. The data from students' responses to the game were analyzed by

calculating the percentage using the Guttman scale score, where a score of 1 was assigned to a "Yes" answer and 0 to a "No" answer. The next step was to calculate the total number of "Yes" responses using the following formula:

$$\text{Response} = \frac{Jumlah\ sor\ pengumpulan\ data}{skor\ kriteria} \times 100\%$$

Figure 1. Formula of Students' responses

The percentage results are then interpreted according to the scores in the table below.

Table 1. Percentage of students' responses

Percentage	Descriptions
1% - 20%	Not good
21% - 40%	Less good
41% - 60%	Quite good
61% - 80%	Good
81% - 100%	Very good

The data from students' responses to the game is considered good if the percentage is ≥ 61%.

RESULTS AND DISCUSSIONS

Student Learning Outcomes

This research was conducted on May 1, 2020, with one class of 28 students from class XII MIPA 3 at Senior High School 2 Ngawi. The results obtained include the students' learning outcomes in the form of pretest and posttest scores, as well as students' responses to *The Red and Ox* game as a learning media.

This game is adapted from the Super Mario game. Within the game, there are 3 levels, and the material is presented in the form of narratives and videos to help students understand redox material more easily. In this game, the player acts as Red, who needs help to find an ancient artifact located in a secret dimension. To reach it, the player must overcome various obstacles. These obstacles contain questions that must be answered by the player.

Before being given *The Red and Ox* game, students first completed a pretest simultaneously through Google Forms. The test

consisted of 16 multiple-choice questions. After completing the pretest, students downloaded *The Red and Ox* game via the Google Drive link provided. Once the students had downloaded the game, they could use it directly. In this remote learning setup, students were able to complete the game up to the final level. The game consists of 3 levels, each with its own focus. If students failed, they were allowed to replay the game. To ensure optimal online learning, monitoring was conducted through a WhatsApp group to track students' progress and the difficulties they encountered while operating the game. After playing *The Red and Ox* game, students then completed the posttest available on Google Forms.

The results of student learning before and after operating *The Red and Ox* game through online learning during the COVID-19 pandemic are as follows.

Table 2. Students' Learning Outcomes

Test	Average score	Passing grade (%)
Pretest	23,9	0,00
Posttest	80,8	85,7

Based on the data presented in Table 2, students obtained pretest scores below the Minimum Criteria of Mastery Learning (≥75), meaning all students were considered unsuccessful during the pretest on redox material.

Of the 28 students, 3 did not achieve passing scores during the posttest. This was because these students found it difficult to operate the game, as indicated by their responses to the statements "I do not feel bored if learning uses *The Red and Ox* game media during the COVID-19 pandemic" and "I want to play *The Red and Ox* game continuously during the COVID-19 pandemic," to which they disagreed. The remaining 26 students achieved passing scores on the posttest, above the Minimum Completion Criteria (KKM). There was a classical improvement from 0.00% in the pretest to 85.7% in the posttest. According to constructivist theory, this improvement occurred due to the learning process, which is an active activity where students build their understanding. Learning is an effort to connect new experiences or

information with prior knowledge, allowing for the further development of understanding [13].

To determine whether there is a significant difference between the average pretest and posttest scores, a paired t-test must be conducted. However, before performing the paired t-test, normality testing should first be conducted using the Kolmogorov-Smirnov test. The results obtained are shown in the table below.

Table 3. Results of Kolmogorov-Smirnov Test

	Pretest	*Posttest*
N	38	28
Std. Deviation	12.38998	12.49173
Kologorov-smirnov Z	1.039	1.132
Asymp. Sig. (2-tailed)	.230	.154

Based on Table 3 above, the significance value of the pretest and posttest scores is above 0.05, indicating that the data is normally distributed. Since the significance value is greater than 0.05, the paired t-test can be conducted because it meets the required conditions.

Table 4. Result of Paired T-Test

		T	*df*	*Sig (2 tailed)*
Pair I	*Pretest - Posttest*	-19.396	27	.000

Based on the data in Table 4 above, the calculated t-score of 19.396 falls within the rejection region for H_0, thus H_0 is rejected with a 95% confidence interval. Since H_0 is rejected, this indicates that there is a significant difference between the pretest and posttest results. The posttest score is higher than the pretest score. This suggests that the Redox game can be used to improve students' learning outcomes.

To determine if there is a significant difference between the average pretest and posttest scores, a paired t-test needs to be conducted. However, before performing the paired t-test, a normality test must first be conducted using the Kolmogorov-Smirnov test. The results obtained are shown in the table below.

Table 5. Results of Gain Score Calculation

Gain score	Criteria	Number of students	Percentage (%)
g > 0,7	High	16	57
0,7 ≥ g > 0,3	medium	12	43
g < 0,3	low	-	-

Based on Table 5, it can be stated that the average gain score of all students is 0.7, which falls under the moderate category. The improvement in learning outcomes observed serves as evidence that one aspect of the effectiveness of using *The Red and Ox* game has been achieved. This aligns with Arsyad's statement that the improvement in processes and achievements can be facilitated through learning media for clearer information presentation [14].

The improvement in learning outcomes achieved by the students is due to the fact that the game contains several obstacles, each of which includes questions related to redox material. As shown in Figure 2 below.
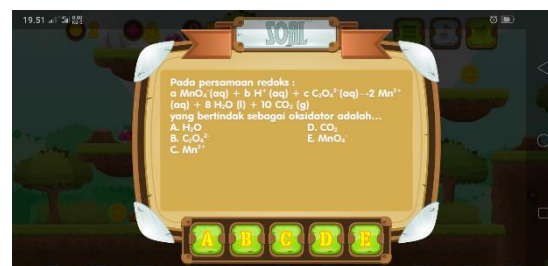

Figure 2. Questions Related to Redox Material in the Game

In addition, the game also includes material not only in the form of narratives but also in video format, which encourages students to pay close attention to the content. This approach helps students in understanding the redox material. This aligns with the opinion expressed by Ain [15].
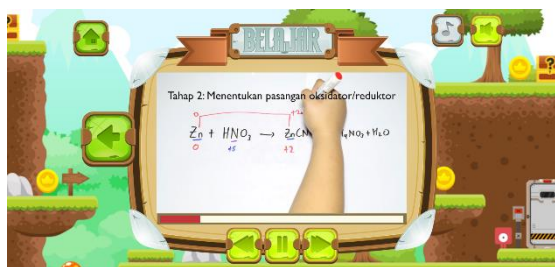
Figure 3. Material in the Form of Video in *The Red and Ox* Game

Especially during the COVID-19 pandemic, which requires students to learn online at home. Based on interviews conducted with teachers from SMAN 2 Ngawi, online learning has several challenges, one of which is the difficulty in making students understand the material. The introduction of this game is expected to assist both teachers and students in the online learning process during the ongoing pandemic.

However, there were 3 students who did not achieve passing scores, primarily due to difficulties in operating *The Red and Ox* game and the slow pace at which they understood the material. Although their posttest scores were below the passing threshold, they still showed improvement in their learning outcomes, placing them in the moderate category. The questions most frequently answered incorrectly by students were related to the indicators "balancing redox reactions in ion form in acidic conditions using oxidation number changes" and "balancing redox reactions in ion form in basic conditions using oxidation number changes." Both of these indicators fall under the symbolic level, as they require students to represent chemical equations and calculate changes in oxidation numbers.

Student Response Survey Results

This study aims not only to assess the students' learning outcomes during the COVID-19 pandemic but also to gather responses or feedback from students regarding the use of *The Red and Ox* game as a learning media. The data for these student responses were obtained from a survey administered to the students after they completed the posttest.

Below are the results of the student responses regarding *The Red and Ox* game as a learning media.

Table 6 Student Response Results After Using *The Red and Ox* Game as a Learning Media

No	Statements	Percentage of Students Who Answered 'YES' (%)
1	I am able to play *The Red and Ox* game smoothly	82,1
2	I understand the rules in *The Red and Ox* game	100
3	*The Red and Ox* game has language that is easy to understand	100
4	I do not feel bored if the learning uses *The Red and Ox* game media during the COVID-19 pandemic	75
5	*The Red and Ox* learning media is fun and interesting to play during the COVID-19 pandemic.	85,7
6	I want to play *The Red and Ox* game continuously during the COVID-19 pandemic.	75
7	*The Red and Ox* game on redox material contains important material that I must understand.	100
8	*The Red and Ox* game makes it easier for me to understand redox material	82,1
Average Percentage of All Students Who Answered 'Yes' (%		87,88

Based on Table 6 above, statements 1, 2, and 3 fall within the range of 81% to 100%, which places them in the "very good" category. This indicates that students were able to easily operate *The Red and Ox* game. Next, statements 4 and 6 fall within the range of 61% to 80%, placing them in the "good" category. This is due to some students experiencing difficulties, as they lacked sufficient memory capacity, which made it challenging for them to operate the game. Additionally, their abilities were sometimes lower compared to their peers. Statement 5 falls within the range of 81% to 100%, which also places it in the "very good"

category. Although there were some minor challenges in operating the game, the overall feedback remains in the "good" category. Students expressed a strong interest in using the game as a learning media, with many wanting to play it continuously.

Statements 7 and 8 also fall within the range of 81% to 100%, placing them in the "very good" category. This proves that the material presented in *The Red and Ox* game is clear and well-understood by the students.

Based on the data obtained from student responses, *The Red and Ox* game as a learning media has proven to be effective in helping students better understand and enjoy chemistry. This is because they felt happy and not bored while learning chemistry through play, and experienced a sense of engagement that motivated them to continue playing the game. This, in turn, increased their desire to keep learning chemistry. This aligns with Anggraini's statement [12], which suggests that psychologically, a person's interest can significantly influence the achievement of their goals. If students feel interested or happy about something, they are more likely to strive relentlessly to achieve it and not give up easily before reaching their desired outcome. Therefore, *The Red and Ox* game as a media can yield positive results in learning. This is consistent with what Lutfi [10] said, that using games as a medium for chemistry learning can create a more enjoyable chemistry learning experience for students.

Based on the learning outcomes and student responses, there is alignment between the two. This is evidenced by the students' interest in the game, which motivated them to play continuously, leading to the achievement of classical learning mastery. As a result, the effectiveness of *The Red and Ox* game as a learning media was successfully achieved.

CONCLUSION AND SUGGESTIONS
Conclusion

Based on the research results and discussion above, it can be concluded that:

1. *The Red and Ox* game as a learning media for redox reactions is considered effective, as students' learning outcomes showed improvement with a pretest score of 23.9 increasing to 80.8 on the posttest, achieving a classical completeness rate of 85.7%. There was an increase in the N-gain score of 0.7, which falls into the moderate category, indicating a significant difference between the pretest and posttest scores.

2. The results from the student response questionnaire show that *The Red and Ox* game, as a learning tool, helps students better understand and enjoy chemistry. By using an engaging media, students do not feel bored; instead, they become interested and happy to learn chemistry while playing. As a result, they are more inclined to continue playing and to learn more about chemistry.

Suggestions

The suggestion from this research is that before starting the learning process with the game, students should be properly prepared so that when the lesson begins, they can use the available time more effectively and finish on time. A larger memory capacity is needed to play well, and gaming skills are also required to operate the game smoothly. This way, students will not feel bored and will be motivated to play continuously.

REFERENCES

[1] Sukmadinata, S. N. (2017). *Metode Penelitian Pendidikan.* Bandung: PT. Remaja Rosdakarya.

[2] Mulyasa. (2013). *Pengembangan dan Implementasi Kurikulum 2013.*

[3] Cahyadi, R. H., & Lutfi, A. (2020). Development of Red and Ox Game for Android Mobile Phone as Learning Media for Balencing Equation. *Journal of Chemistry Education Research*. UNESA.

[4] Yulianingtyas, E., Budiasih, E., & Marfuah, S. (2017). Pengaruh Penggunaan Jurnal Belajar dalam Model Pembelajaran Learning Cycle 6E Terhadap Kesadaran Metakognitif Siswa SMAN 8 Malang pada Materi Redoks. *Jurnal Pendidikan: Teori Penelitian, dan Pengembangan,* (h. 724-730).

[5] Lutfi, A., & Rahmawati, A. (2018). The Development of Super Chem Game Oriented Android as Instructional Media Electrolyte and Non-Electrolyte. *Journal of Chemistry Education Research*. (h. 1-10). UNESA.

[6] Suryaman, M., & Utorodewo, V. N. (2006). *Pemilihan dan Pemanfaatan Buku Pelajaran yang Memenuhi Syarat Kelayakan.* Jakarta: Pusat Perbukuan Departemen Pendidikan Nasional.

[7] Widani, N. K. (2017). Penggunaan Media Audiovisua untukMeningkatkan HasilBelajar Kelas XII IPA 1 Sekolah Menengah Atas Negeri 1 Petang. *Jurnal Santiaji Pendidikan*, (h. 200-207). UNMAS

[8] Khasanah, R. D., Pramudibya, H., & Widuroyekti, B. (2020). Pendidikan dalam Masa Pandemi Covid-19. *Jurnal Sinestesia*, (h. 41-48).

[9] Pujilestari, Y. (2020). Dampak Positif Pembelajaran Online dalam Situasi Pendidikan Indonesia Pasca pandemi Covid-19. *ADALAH: Buletin Hukum dan Keadilan*, (h. 49-56). UIN Syarif Hidayatullah

[10] Lutfi, A., Suyono, Erman, & Hidayah, R. (2019). Edutainment eith Computer Game as A Chemistry Learning Media. *JPSS (Jurnal Penelitian Pendidikan Sains)*, (h. 1684-1689). Unesa

[11] Sudjana, N., & Rivai, K. (2011). *Media Pengajaran.* Bandung: Sinar Baru Algensido.

[12] Lutfi, A., & Nugroho, A. (2019). Minat Belajar dan Keberhasilan Belajar Partikel Penyusun Atom dengan Media Pembelajaran Permainan Chem Man. *Jurnal Pembelajaran kimia*, (h. 39-50). Universitas Negeri Malang

[13] Sadiman, A. S. (2014). *Media Pendidiikan: Pengertian, Pengembangan dan Pemanfaatannya*. Depok: PT. Raja Grafindo Persada.

[14] Sukmawati, E., & Fauziyah, N. M. (2017). Penerapan Media Permainan Science Wiqu Game untuk Meningkatkan Hasil Belajaran Siswa pada Materi Perubahan Fisika dan Kimia. *E-Journal Pensa,* (h. 237-242). UNESA

[15] Ain, T. N. (2013). Pemanfaatan Visualisasi Video Percobaan Gravity Current untuk Meningkatkan Pemahaman Konsep Fisika pada Materi Hidrostatis. Jurnal Inovasi Pendidikan Fisika, (h. 97-102.) Unesa