

Amplifying Students's Understanding of the Basic Concept of the Periodic Table through Wordwall in the Coastal School of Riau Islands

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Abstract. Learning media has an important role in reinforcing chemistry materials, especially the periodic table. The study aims to develop Wordwall as an educational media in strengthening the understanding of the periodic system table in coastal school. The study uses Research and Development with the ADDIE research method until the implementation stage. This media was validated by 2 lecturers of Chemistry Education at Raja Ali Haji Maritime University. From the material expert, the results obtained were 92.5% with very valid information, while from the media expert, 75% was obtained with valid information in the first stage and 85% with very valid information in the second stage. Meanwhile, the results of teacher practicality obtained 83.33% with a very valid statement and the results of student practicality with two aspects, the effectiveness aspect obtained 81.42% with a very effective statement and the attractiveness aspect obtained 77.33% with an interesting statement. With this research, it can be concluded that the learning media for strengthening understanding of the periodic table is very valid, very effective, and interesting to use in the learning process in coastal schools in the Riau Islands.

1 Introduction

Education is an important foundation in driving the progress of every country. This is because education acts as the main foundation in preparing every citizen to face the transformation that occurs [1]. One of these transformations is the rapid development of technology that encourages elements in education to keep up with these developments [2].

The development of technology has changed the way teaching and learning takes place in the classroom. Technology has facilitated wider, more interactive and engaging access to education for students [3]. The use of digital devices, such as computers, smartphones and tablets, allows students to learn online [4]. In addition, technology has also changed the teaching paradigm with the emergence of e-learning and blended learning methods. Through technological transformation, students can also access extensive and up-to-date educational resources, global collaboration, exchange of ideas, and enhance their understanding of concepts such as the periodic table.

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The periodic table, as a visual representation of chemical elements, provides important information about the properties and relationships between elements. However, students often face difficulties in understanding the definitions and applying the concepts of the periodic table in relevant contexts [5]. For example, understanding the determination of element classes and periods, the relationship between atomic numbers and element properties, and how to use the periodic table in determining electron configurations. Moreover, chemical elements are not a language that is often heard so it takes a strong memory to understand it. Not only that, Bernardo and González in their research which states that the mastery of the concept of the periodic system table of elements is still low even though they have received an explanation from the teacher. This is because the teacher's approach feels boring during the learning process [6]. Therefore, this problem encourages the development of media innovation in education to help students understand and master the periodic table more effectively.

In learning the periodic table, one way to provide reinforcement is to use Wordwall. Wordwall is a platform that offers various interactive activities to improve students' mastery of the material. In the Wordwall platform, students can interact with various kinds of learning content such as flashcards, puzzles, matching games, and so on [7]. This media has the advantage that this application can be used with devices and laptops without requiring a special place [8]. Wordwall can also be accessed offline and online which is suitable for use in areas where it is difficult to get a signal. In addition, Wordwall is able to provide optimal results when used by students by showing good learning outcomes [9]. Increased learning outcomes make student responses positive so that learning motivation also increases because students are happy to be able to explore their own concepts [10].

Therefore, this research aims to develop Wordwall as an educational media in strengthening the understanding of the periodic system table of elements. The researchers hopes that with this study, students can strengthen their memory for better understanding through an interactive approach and the use of digital resources. This is to achieve success in understanding the periodic table and related chemical concepts.

2 Methods

The research uses Research and Development with the ADDIE method. However, this research only uses 4 stages, namely analysis, design, development, and implementation. This is because this study aims to review the effectiveness of Wordwall educational media on students in coastal schools only.

In the analysis stage, the author identified problems through literature review related to students' difficulties in determining the class and period of elements in the periodic table. The data sought focused on students in coastal schools, especially the Riau Islands. The identification of this problem was then used as further research material in finding suitable media used in coastal areas. This stage was carried out from 10-20 May 2023.

Furthermore, in the design stage, the product design of the Wordwall development was carried out by visually describing the media sketch. The product design is adjusted to the available elements according to student needs. In addition, the design of assessment instruments was also carried out in the form of questionnaires for material validation, media validation, chemistry teacher and student responses. For students, the type of questionnaire used is a closed questionnaire where the research subject only chooses answers using google form. The media and questionnaire design stage was carried out from 20-27 May 2023.

At the development stage, educational media in the form of Wordwall web pages were developed in accordance with the previous design. The development of this design was carried out from 27 May-02 June 2023. The tool needed in the learning media design

development process is a laptop. A laptop is an important tool in this research because it can facilitate the manufacturing process rather than using a mobile phone. Furthermore, the media was validated by 1 lecturer and material validation by 1 lecturer who is a chemistry education lecturer at UMRAH. Validation was carried out on 03-06 June 2023. Validation is carried out to see what needs to be revised in the media and followed up to make revisions.

In the implementation stage, Wordwall media was implemented to 1 chemistry teacher and 10 students of class X MIPA SMA Negeri 1 Bintan Timur. Media implementation was carried out on 08 June 2023. Each student will be given a questionnaire to provide an assessment of the learning media. Before using the product, the researcher ensured that students had obtained the material by introducing the periodic system table of elements.

The data obtained were then processed with quantitative data analysis techniques from validators, chemistry teachers and students. Data from validators were calculated based on a Likert scale as in Table 1 [11].

Table 1. Likert scale

Assessment	Score
Very good	5
Good	4
Good enough	3
Less good	2
Very poor	1

The score is then calculated using the formula:

$$P(\%) = \text{sum of the scores obtained} / \text{maximum scores} \times 100\% \tag{1}$$

Furthermore, the percentage results were processed based on the validity scale shown in Table 2.

Table 2. Scale of validity

Assessment	Score
Invalid	0% - 20%
Less Valid	21% - 40%
Quite Valid	41% - 60%
Valid	61% - 80%
Very Valid	80% - 100%

The data to see the effectiveness was calculated based on a Likert scale with a score of 1- 5 with a description of very unhelpful-very helpful. In addition, there is a score calculated based on the criteria "yes" with a score of 1 and "no" with a score of 0. The score is then calculated by the formula:

$$P(\%) = \text{sum of the scores obtained} / \text{maximum scores} \times 100\% \tag{2}$$

Furthermore, the percentage results were processed based on the effectiveness scale shown in Table 3.

Table 3. Effectiveness scale

Assessment	Score
Ineffective	0% - 20%
Less Effective	21% - 40%
Quite Effective	41% - 60%
Effective	61% - 80%
Very Effective	80% - 100%

Data to calculate the attractiveness by considering the feeling of pleasure in using the media is calculated based on a Likert scale with a score of 1-5 with a description of very unpleasant-very pleasant. The score is then calculated by the formula:

$$P(\%) = \text{sum of the scores obtained} / \text{maximum scores} \times 100\% \tag{3}$$

Furthermore, the percentage results are processed based on the attractiveness scale shown in Table 4.

Table 4. Attractiveness scale

Assessment	Score
Not Attractive	0% - 20%
Less Attractive	21% - 40%
Quite Attractive	41% - 60%
Attractive	61% - 80%
Very Attractive	80% - 100%

3 Results and Discussion

In this study, results were obtained in order to strengthen the understanding of the periodic table list through Wordwall. These results will be discussed below.

1. Analysis Stage

Based on the literature review, the determination of groups and periods in the periodic table is still a problem because this material uses the memory method in understanding it. This has been experienced by students who attend schools in coastal areas. According to research Ahlan Rezki, as many as 64.38% of class X students of SMAN 1 Bayang Utara in Pesisir Selatan, West Sumatra experienced difficulties and felt confused about the elements in the periodic table [12]. Not only that, a similar incident also occurred in Bintan Bay, Riau Islands. In Lisa Sulistiawati’s research revealed that as many as 65.52% of students in class X MIPA SMAN 1 Teluk Bintan made mistakes in determining the class and period of an element. This is because students do not understand the concept of the element period system [13].

Therefore, media development needs to be done to help students remember the class and period of an element. Learning media development can be done by changing conventional media to digital media to make learning more interesting [14]. This can be proven from the results of research conducted by Sari said that digital learning media can help students in learning vocabulary as an alternative media in teaching so that students can develop creativity [15]. In another study, Zaharani stated that digital media can help children learn foreign languages quickly and learning activities become less boring [16].

2. Design Stage

At this stage, there are two stages in designing Wordwall learning media. The stages are as follows:

a. Wordwall webpage development design

The Wordwall design is visually designed starting from selecting the game background, and creating the game flow by arranging several classes. Within the classes, there are five elements that will be arranged freely. Then, it goes into the time editing stage.

b. Preparation of assessment instruments

The preparation of the assessment instrument in the form of a questionnaire was carried out by determining the assessment aspects and formulating modified statements. The modification of the statement was carried out from research Siahaan et al to assess products based on a Likert scale^[17]. The results of the preparation of research instruments are intended for material expert validators, media expert validators, chemistry teachers and students who are used as research samples. The material expert validation questionnaire was prepared with 8 statements, the media expert validation questionnaire was prepared with 12 statements, and the teacher's practicality questionnaire was prepared with 6 statements.

In addition, students also filled out the questionnaire. The student practicality questionnaire was prepared with 10 statements. Indicators used to ensure the effectiveness and attractiveness after the use of Wordwall media in making a list of periodic system tables of elements.

3. Development Stage

At this stage, it begins with product creation. Product creation is done by realising the website into a real product. In the initial display, the research subject will be asked to fill in personal name data. After that, there are instructions for using Wordwall media and the game will start a few seconds later. The following are the views of the Wordwall learning media developed by the researcher.

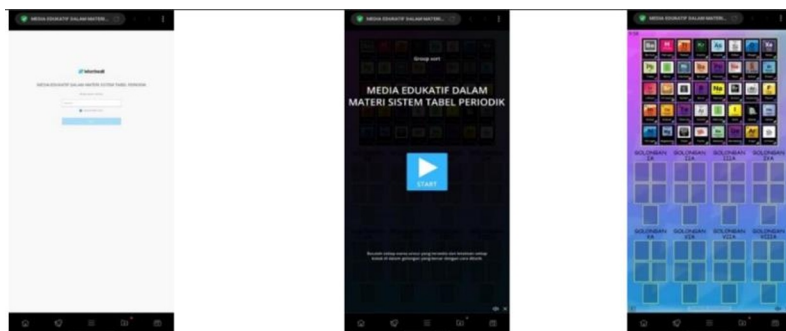


Fig. 1. Media Page

Furthermore, the dissemination of Wordwall media was done by sharing the link. The link was shared with the validators first. Product validation was carried out by distributing questionnaires to both validators to determine the validity level of the product. The results of the material expert validation conducted by Mr. Hilfi Pardi, S. Si., M. Si. obtained an overall percentage value of 92.5%. These results indicate that this media is very valid where it is in the 80%-100% range. The advice given is that chemical writing in Wordwall media should be paid more attention to.

Meanwhile, media expert validation was carried out twice by Mr. Ardhi Widhia Subekti, S. Pd., M. Pd. In the first validation, the product validation results got an overall percentage of 75% with valid criteria, but needed to be revised following the suggestions. The suggestions mentioned were to fix the name of the material according to the standard, fix the final letter "N" in the writing "Group" cut off with an upright screen display, clarify the instructions and make the appearance of the instructions and pages more attractive. The word "dragged" in the instruction is replaced with the word "pulled", the correct answer does not need to be displayed, loading game entry is too long and is made to be accelerated, the element symbol that still has a white background is replaced with another image and the lead symbol is not yet clearly visible are things that are also suggestions for the development of this media.

Then, the revision of the development product was carried out following the suggestions above. The validation results at the second validation stage obtained an overall percentage of 85%. The percentage is included in the very valid category so that this media product is suitable for use.

4. Implementation Stage

After the Wordwall media received validation by both, the media was tested for practicality to 1 chemistry teacher and 10 students of class X SMA Negeri 1 Bintan Timur. The samples of this study were students selected following the advice of the chemistry teacher at SMA Negeri 1 Bintan Timur.

The teacher's practicality test was carried out after media and material validation was carried out by giving a questionnaire. From this test, the percentage of practicality obtained a result of 83.33%. This result is included in the description very valid because it is within the percentage of 81%-100%.

The results of students' responses were taken by giving questionnaires related to Wordwall media after its use. The data taken there are two aspects in it, namely aspects of effectiveness and aspects of attractiveness. The data from both are presented as follows:

Table 5. Wordwall Effectiveness Statement

No.	Question	Effectiveness Scale					Total
		1	2	3	4	5	
1.	Do you think the media helped you to strengthen your understanding of the basic concepts of the periodic table?			4	4	2	38
No.	Question	Effectiveness Scale					Total
		Yes (1)		No (0)			
1.	Do you think Wordwall is easy to use?	9		1			9
2.	Would you like to use this Wordwall learning media again?	10		0			10

The data scores in Table 5 are then calculated using a formula where the maximum score is 70:

$$P(\%) = 57/70 \times 100\% = 81,42\%.$$

(4)

This data is then presented as a pie chart as shown in Figure 2.

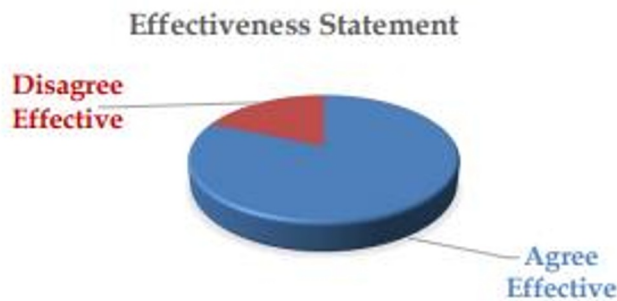


Fig. 2. Wordwall Effectiveness Percentage

Table 6. Wordwall Attractiveness Statement

No.	Question	Effectiveness Scale					Total
		1	2	3	4	5	
1.	How did you feel after playing the educational media?			2	4	4	42
2.	Are you happy with the colours used in the media?		1	2	4	3	39
3.	Are you happy with the music available on the media?	1	2	2	1	4	35

The data scores in Table 6 are then calculated by the formula where the maximum score is 150:

$$P(\%) = 116 \div 150 \times 100\% = 77.33\% \tag{5}$$

This data is then presented as a pie chart as shown in Figure 5.

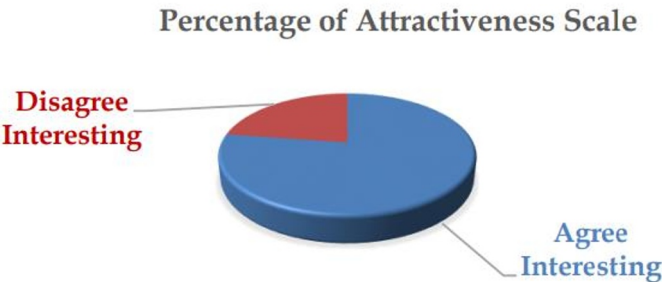


Fig. 3. Wordwall Attractiveness Percentage

Based on the two pie charts above, Wordwall in terms of effectiveness and attractiveness received a percentage of 81.42% and 77.33% respectively. These percentages show that Wordwall received positive responses from students. The criteria obtained are very effective and interesting.

From the aspect of effectiveness, these results are in line with previous research by Arimbawa obtained research results that Wordwall has successfully acted as a tool to improve student learning achievement in biology subjects where the average learning achievement score is 84.00 with very good criteria, absorption rate is 88% and classical completeness is 100% [17,18]. In addition, Hartatiningsih conducted a study by showing the results of the study, namely the use of Wordwall media can facilitate the learning process of students in improving their vocabulary knowledge. It was proven by their vocabulary skills that developed after its use [19]. Lubis and Nuriadin also obtained

positive research results where Wordwall media is very effective in learning because it can improve children's learning outcomes [20].

From the aspect of attractiveness, the results of the research obtained by researchers in the form of interesting criteria are in line with research conducted by Nurmelati who obtained research results in the form of student learning motivation after using Wordwall in the good enough category with an average percentage score of 70.15% [21]. This result shows that the factor that influences students' learning motivation is that Wordwall media is attractive with its features that have been provided. Similar to that, Nenohai et al. found that the response from students as media users gave a very positive response to help them learn reaction rate material in a fun and attractive way with a game-based display [22]. The research data that supports his research is an average percentage of 81.75% of 37 students and this data is included in the category worthy of use so as to increase student interest in its use.

Based on the above explanation, the results of this study show that Wordwall media in order to strengthen students' understanding in coastal schools in Riau Islands related to the periodic table of elements is considered effective. Good and interesting learning media can increase the effectiveness of the learning process. Students' enthusiasm for learning can increase when teachers use this digital-based learning media.

4 Conclusions

Based on the findings of this study, the use of educational media can play a major role in learning activities. Wordwall media modified by researchers was able to strengthen the understanding of the basic concepts of the periodic table in accordance with the research objectives. The results of the study, namely from material experts, obtained results of 92.5% with very valid information, while from media experts, obtained 75% with valid information in the first stage and 85% with very valid information in the second stage. Meanwhile, the teacher's practicality results obtained 83.33% with a very valid statement. For students, the practicality results consisted of two aspects, the effectiveness aspect obtained 81.42% with a very effective description and the attractiveness aspect obtained 77.33% with an interesting description. Therefore, these results prove that learning media in order to strengthen students' understanding in coastal schools in Riau Islands related to the periodic table of elements is considered effective and interesting.

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References

1. F. Sugiharto, Q. Nurani, JIP, **2**, 89 (2022)
2. A. Nursyifa, JPKN, **6**, 52 (2019)
3. E. Firmansyah, M. Nurul Humaidi, JE, **8**, 660 (2022)
4. F. Achlikul Zahwa, I. Shafi'i, Equi, **19**, 63 (2022)
5. M. Arzu Uyulgan, N. Akkuzu Güven, ITALL, **3**, 92 (2022)
6. J. M. Montejo Bernardo, A. Fernández González, J. Chem. Educ, **98**, 907 (2021)
7. A. Auliya, S. Suhirman, N. Latipah, Tarbiyah : JIK, **10**, 74 (2021)

8. D.Oktariyanti, A. Frima, Riduan Febriandi, Jurnal Basicedu, **5**, 4094 (2021)
9. B. Ata Gusman, U. Hanifah Salsabila, H. Hoerotunnisa, L. Yahsa Giardi, V. Fadhila. *Intelektual : JI*, **11**, 219 (2022)
10. N. Maulia Agusti, A. Aslam, Jurnal Basicedu, **6**, 5796 (2022)
11. N. Bintingtiyas, UJCED, **5**, 168 (2016)
12. A. Rezki, R. Dwi Agustia, E. Library Unikom, (EDP Sciences, Riau Island, 2019)
13. L. Sulistiawati, E. Putra Ramdhani, I. Yulita, SOJ UMRAH, **1**, 503 (2020)
14. S. Syarifuddin, E. Dewi Utari, *Media Pembelajaran (Dari Masa Konvensional Hingga Masa Digital)*, (Palembang, Bening Media Publishing, 2022)
15. R. Novita Sari, R. Nazmi, Z. Zulfa, Jurnal Unimed, **6**, 82 (2021)
16. H. Zaharani, Jurnal Unimed, **6**, 108 (2021)
17. R. Siahaan, M. Sitorus, S. Silaban. JPKIM, **13**, 64 (2021)
18. I. Gusti Putu Agung Arimbawa, IJED, **2**, 324 (2021)
19. D. Hartatiningsih, Jurnal P4I, **2**, 303 (2022)
20. A. Putri Lubis, I. Nuriadin, Jurnal Basicedu, **6**, 6884 (2022)
21. M. Nurmelati, Edutech, **2**, 339 (2023)
22. J. Anggara Nenohai, D. Ainur Rokhim, N. Indah Agustina, M. Munzil, *Orbital: Electron. J. Chem.* **14**,116 (2022)