Jurnal Paedagogy:
Jurnal Penelitian dan Pengembangan Pendidikan
https://e-journal.undikma.ac.id/index.php/pedagogy/index
Email: paedagogy@undikma.ac.id

Vol. 10 No. 3 : July 2023
E-ISSN: 2722-4627
pp. 692-702

Development of a WordPress-Based Learning Website to Train Students' Visual Intelligence on Chemical Equilibrium Material

Putri Nur Azizah, Achmad Lutfi*
Departement of chemistry education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya
*Corresponding Author. Email: achmadlutfi@unesa.ac.id

Abstract: This research aims to develop a WordPress-based chemistry learning website that can train students' visual intelligence on chemical equilibrium material. This study used the 4D development model (Define, Design, Develop, and Disseminate), which was limited to the development stage with limited trials conducted in class XI SMAN 1 Cerme Gresik. The instruments used in this study were media validation sheets, practicality questionnaires, student activity observation sheets, and cognitive and visual intelligence learning outcomes test sheets. The data from this study were analyzed descriptively quantitatively, with a validity score of≥3, a percentage of practicality obtained ≥61%, and the effectiveness analyzed using N-Gain and t-test. The results showed that WordPress-based chemistry learning website media was feasible to use and could train visual intelligence to students. That is because chemistry learning websites have mode four validity, categorized as very valid. Then the percentage of practicality obtained from the student response questionnaire was 96.21% with a very practical category and was measured by observing student activities with relevant activities at meeting 1 of 91.85% and meeting 2 of 90.74% so that the media can be said to be very practical. The effectiveness of the media was measured based on the posttest results with the N-Gain score obtained on cognitive learning outcomes of 0.75 and visual intelligence learning outcomes of 0.73 with a high category so that the website media was said to be effective. Wilcoxon test results showed that cognitive learning outcomes had a significance value of 0.000, and visual intelligence learning outcomes had a significance value of 0.000, indicating a significant variation between pretest and posttest results because of the significant value <0.05.

Article History
Received: 02-05-2023
Revised: 05-06-2023
Accepted: 29-06-2023
Published: 17-07-2023

Key Words:
Visual Intelligence; Website Media; Chemical Equilibrium.

How to Cite: Azizah, P., & Lutfi, A. (2023). Development of a WordPress-Based Learning Website to Train Students' Visual Intelligence on Chemical Equilibrium Material. *Jurnal Paedagogy, 10*(3), 692-702. doi:https://doi.org/10.33394/jp.v10i3.7994

https://doi.org/10.33394/jp.v10i3.7994

Introduction

Education is currently in the 21st century, with great challenges in preparing resources capable of dealing with information and communication technology advances. The progress of science, technology, and communication has changed life (Rawung et al., 2021). Science and technology advancement has significantly influenced the realm of education, especially in terms of innovation in the learning process (Uno, 2016). That is reinforced by government policies on Permendikbud Number 65 of 2013, paragraph 13 states that using ICT in education can increase the efficiency and effectiveness of learning (Kemendikbud, 2013). One of science and technological progress in education is the shift from the use of conventional media to ICT-based media (Almahfuz, 2021).

Educational media are educational equipment to deliver data to achieve educational goals and help students get a concept (Kristanto, 2016). Technology-based learning media can function as interactive media for students to understand learning material in terms of visual, audio, and text (Hasan et al., 2021). The use of educational media in the application of chemistry education is essential (Kartini & Putra, 2021). That is because chemistry concepts are typically complex and abstract, so the learning process requires scientific reasoning, likely making pupils have trouble learning (Hidayah & Sugiarto, 2019).

Chemistry can be explained with three different representation levels: macroscopic, submicroscopic, and symbolic. Macroscopic representation in chemistry is a concrete level representation because students can observe phenomena that occur directly; submicroscopic representation is an aspect that shows chemical characteristics that has an abstract impression which is used to explain macroscopic phenomena in the form of explanations using images in the form of atoms, molecules, or ions so that the phenomena that occur cannot be observed directly. In contrast, symbolic representation uses atomic symbols, molecular formulae, mathematical equations, chemical equations, graphs, analogies, and reaction processes to depict macroscopic phenomena (Rosmiati, 2022). One of the abstract chemical materials is chemical equilibrium (Sukarmin & Sugiarti, 2019). Chemical equilibrium material is used in this study because, according to the results of interviews with chemistry teachers at SMA Negeri 1 Cerme, chemical equilibrium is one of the tricky materials to understand for class XI students; this is shown by the daily test scores of students obtained from the teacher showing that 83.78% of students in the class are still not complete.

In chemical equilibrium, learn about Le Chatelier's principle, which states that equilibrium can change or shift if the equilibrium mixture has a disturbing factor (Pongkendek & Kristyasari, 2022). Chemical equilibrium shift reactions are addressed in the chemical equilibrium shift sub-material and can be caused by different factors, including concentration, temperature, volume, and pressure which pupils will find challenging to grasp if it is only expressed by the reaction equation because it does not describe the dynamic equilibrium process that occurs at the submicroscopic level (Utari et al., 2017).

The lack of understanding of the concept of chemical equilibrium is due to the difficulties experienced by students in hooking up the three chemical representations (Wati & Novita, 2021). It is crucial to visualize chemical representation in chemical equilibrium, especially at the submicroscopic and macroscopic levels, because the process of building visualization requires a high level of visual intelligence to comprehend and translate a visual form (Erlina et al., 2022). Learning outcomes correlate positively with visual intelligence (Sari et al., 2017). According to Haas in Wijaya (2019), visual intelligence has four characteristics: conceptualizing, imagining, problem-solving, and pattern-seeking (Wijaya et al., 2019).

Based on research conducted by Hulu & Dwiningsih (2021) shows high visual intelligence test results in chemistry learning due to the application of interactive multimedia-assisted student worksheet media (Hulu & Dwiningsih, 2021). Based on this, students' visual intelligence must be trained and improved so that students' ability to understand chemical materials at the level of macroscopic, submicroscopic, and symbolic representations, such as chemical equilibrium material, can be increased (Pratamadita & Dwiningsih, 2021).

It is necessary to innovate in chemistry learning to increase students' learning motivation so that good learning achievement will be produced by using technology-based educational media, especially in chemical equilibrium (Lubis & Ikhsan, 2015). Learning websites are one way to use interactive learning material based on ICT. Based on the relevant research, there is already a website for studying chemistry built on WordPress that is similar but differs technically and materially, namely a website for studying chemistry built on WordPress that is integrated with Moodle on the periodic system of elements. The findings

Jurnal Paedagogy:
Jurnal Penelitian dan Pengembangan Pendidikan
https://e-journal.undikma.ac.id/index.php/pedagogy/index
Email: paedagogy@undikma.ac.id

Vol. 10 No. 3 : July 2023
E-ISSN: 2722-4627
pp. 692-702

indicated that chemistry learning websites could enhance student learning outcomes in the periodic system of elements (Huda & Dwiningsih, 2021). Either the platform that can be used to develop learning websites is WordPress, with the advantages of being easy and lightweight to access and free of charge (Pratama & Effendi, 2021). This research aims to develop a chemistry learning website on chemical equilibrium material that is feasible to use and can train visual intelligence in students, which is expected to improve students' cognitive learning outcomes and visual intelligence.

Research Method

Research and development (R & D) was the research method employed in this study using the 4D model adapted from Thiagarajan (1974), which has been modified by (Sutarti & Irawan, 2017). The steps of the 4D model were defined, designed, developed, and disseminated. It was only up to the developing stage examined in this study. The research scheme using the 4D model is as follows.

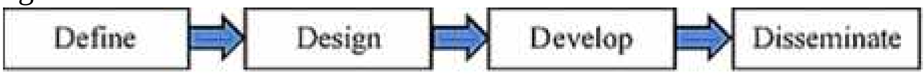


Figure 1. 4D Model Stages

The data obtained from this study were analyzed descriptively and quantitatively. The feasibility of the produced media was determined by assessing its validity, practicality, and effectiveness. Validity was evaluated by analyzing data provided by experts conducting content and construction validation. Practicality and effectiveness were analyzed based on information gathered from the outcomes of restricted product trials conducted at SMAN 1 Cerme Gresik with test subjects of class XI students who were randomly selected. The score validity sheet was obtained using the Likert scale (Lutfi, 2021).

Table 1. Likert Scale Score

Score	Criteria
1	Totally Invalid
2	Invalid
3	Valid
4	Very Valid

Validation results were analyzed by determining the mode at each point which was validated by deciding if the mode ≥ 3 points were declared valid and the mode < 3 points were declared invalid (Lutfi, 2021). Practicality was analyzed through data from student response surveys and observations of student activities. Student responsed survey data used the Guttman scale as follows (Riduwan, 2015).

Table 2. Guttman Scale Score

Statement	Evaluation	
	Yes	No
Positive	1	0
Negative	0	1

Data obtained from the student response survey were analyzed by looking for the practicality percentage of the answers given by students with the following formula.

$$\%\ Practicality = \frac{score\ obtained}{maximum\ score}\ x\ 100\%$$

Observation of student activity was taken out during learning with an interval of 2 minutes. The data obtained was then calculated by the following formula:

$$\%\ Activity = \frac{Amount\ of\ student\ activities\ that\ appear}{maximum\ amount\ of\ activity}\ x\ 100\%$$

Jurnal Paedagogy:
Jurnal Penelitian dan Pengembangan Pendidikan
https://e-journal.undikma.ac.id/index.php/pedagogy/index
Email: paedagogy@undikma.ac.id

Vol. 10 No. 3 : July 2023
E-ISSN: 2722-4627
pp. 692-702

Furthermore, the results obtained were interpreted into the following category.

Table 3. Practicality Score Interpretation

Practical Percentage (%)	Criteria
0 – 20	Very Impractical
21 – 40	Impractical
41 – 60	Practical Enough
61 – 80	Practical
81 – 100	Very Practical

A WordPress-based learning website that focused on chemical equilibrium material was considered practical if the percentage of practicality and students' activity was more than 61%. ≥ 61% (Riduwan, 2015). Effectiveness was analyzed through students' cognitive learning outcomes and visual intelligence data, both pretest and posttest. Learning outcomes data were analyzed using N-Gain, and a t-test was taken out to find a variation between the mean pretest and posttest learning outcomes. To calculate the N-Gain, the Hake equation can be used as follows.

$$N-Gain = \frac{Posttest\ score - Pretest\ score}{Maximum\ score - Pretest\ score}$$

The following table is used to interpret the N-Gain (<g>) calculation results.

Table 4. N-Gain Score Interpretation

N-Gain score (<g>)	Category
$\langle g\rangle \geq 0,7$	High
$0,7 > \langle g\rangle \geq 0,3$	Medium
$\langle g\rangle < 0,3$	Low

Student learning results can be said to have increased, and learning websites based on WordPress on chemical equilibrium are thought to be effective if the N-Gain score is ≥3 or is in the high or medium category (Sundayana, 2014). The normality test was carried out in the learning outcomes data as a condition before the t-test was taken out. The normality test used was the Shapiro Wilk normality test carried out with SPSS based on decision making; the data have a normal distribution if the sig value > 0.05, and do not if the sig value < 0.05. (Putri, 2020). If the data have a normal distribution, the paired sample t-test was employed; otherwise, the Wilcoxon test is applied.

Results and Discussion

Define Stage

The first stage of research with the 4D model was the definition stage. At this step, an initial analysis was taken out to identify the needs of the learning process and student learning outcomes, especially visual intelligence learning outcomes. The analysis employed a literature study and pre-research by distributing response questionnaires to 74 SMAN 1 Cerme Gresik and 28 SMAN 1 Krembung Sidoarjo students and interviews with four chemistry teachers.

In the pre-research, a student response questionnaire result was obtained that 69.61% of students regard chemistry studies as difficult to understand. That is because teachers' learning methods and media are still relatively conventional. Most of the students said that the teacher used the direct learning and question and answer method where the method was classified as TCL (teacher-centred learning), while the implementation of the 2013 curriculum and the independent curriculum required SCL (student-centred learning) (Satriaman et al., 2018). The instructional media teachers use in chemistry learning mostly

Jurnal Paedagogy:
Jurnal Penelitian dan Pengembangan Pendidikan
https://e-journal.undikma.ac.id/index.php/pedagogy/index
Email: paedagogy@undikma.ac.id

Vol. 10 No. 3 : July 2023
E-ISSN: 2722-4627
pp. 692-702

only uses textbooks and student worksheets. As a result of interviews conducted with four chemistry teachers, student learning outcomes were still low. One of the materials in class XI that is classified as difficult is chemical equilibrium, especially in determining the direction of a shift in chemical equilibrium based on the concentration, temperature, pressure, and volume factors. It is evidenced by the results of the tests given to 33 students, with an average score of 36.36. This test aims to measure the visual intelligence of students in the chemical equilibrium material and sub-material factors that influence shifts in chemical equilibrium. This material is class XI, specifically KD 3.9 in the 2013 Curriculum.

One teacher stated that media needed that was able to visualize chemical material so that it could attract students to learn chemistry. In addition, it can also realize a more realistic three-level chemical representation. Students also stated that they needed interesting media to increase motivation in learning chemistry. Based on the description above, it is possible to develop Information and Communication Technology-based media to visualize the three levels of chemical representation. One of the media that can be used is a learning website because the website can include text, images, video, and audio so that it can present interaction between the media and students and the teacher as a facilitator (Elu, 2013).

Design Stage

The second stage, namely design or planning, consists of preparing test criteria, selecting media, selecting formats, and the initial design was carried out until the initial product was made (draft I). The preparation of the criterion test is used to link the problems obtained from the defining stage with the design that will be carried out. The low learning outcomes of students' visual intelligence make researchers want to develop a treatment using media to train visual intelligence. The media chosen was a learning website based on WordPress; this is because the media is easy to access anywhere and is free and is interactive media. The next step was to create a storyboard for the initial media design. Website media systematics as follows: (1) opening page; (2) Main Menu; (3) Instructions; (4) Introduction; (5) Material; (6) E-LKPD; (7) Virtual Labs; (8) Quiz; (9) Evaluation; (10) Developer Profile.

STORYBOARD MEDIA *WEBSITE* PEMBELAJARAN KIMIA BERBASIS *WORDPRESS*

Scene	Appearance	Information
Main menu		• At the top there is the title of the material, namely 'Chemical Equilibrium" and the logo of the developer's university • There are 7 main menus on this learning website, namely: a. Instruction e. Virtual lab b. Introduction f. Quiz c. Material g. Evaluation d. E-lkpd • At the bottom is the title of the research that will be carried out.
Material menu		On the material page there are 8 menus, namely: a. Concept map b. Phenomena c. Le-Chatelier principle d. Concentration e. Temperature f. Video g. Volume and pressure h. Chemical equilibrium in industry At the bottom there is a "MENU" button to return to the menu page.

Figure 2. Storyboard Media Website

The next stage was the initial design of the website media based on the storyboard made to produce the initial product in the form of a website for studying chemistry built on WordPress that focuses on chemical equilibrium material. This website was created with the

Jurnal Paedagogy:
Jurnal Penelitian dan Pengembangan Pendidikan
https://e-journal.undikma.ac.id/index.php/pedagogy/index
Email: paedagogy@undikma.ac.id

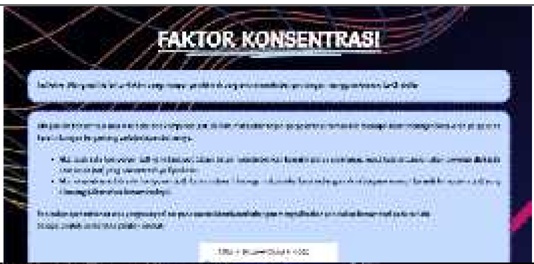
Vol. 10 No. 3 : July 2023
E-ISSN: 2722-4627
pp. 692-702

domain pnachemistry.com. All content created on the website uses the WordPress Content Management System (CMS) integrated with the e-LKPD section's live worksheet.

Figure 3. Website Media That Has Been Developed

Then, the website that has been designed was reviewed by the chemistry education lecturer to get suggestions. After that, the researcher revised the media according to the suggestions given so that draft I of the website would be produced, which would then go through the validation stage.

Table 5. Results of Revision of Media Review

No.	Suggestion	Revised Result
1.	In each part of the material, the indicators are written according to the material	
2.	Given a password for the menu used in the 2nd meeting. This is done so that students focus on opening the menu in sequence and not randomly.	

Jurnal Paedagogy:
Jurnal Penelitian dan Pengembangan Pendidikan
https://e-journal.undikma.ac.id/index.php/pedagogy/index
Email: paedagogy@undikma.ac.id
Vol. 10 No. 3 : July 2023
E-ISSN: 2722-4627
pp. 692-702

No.	Suggestion	Revised Result
3.	In the video section, initially use sentences to support your understanding. The word understanding is replaced so as not to impress category C2.	

Develop Stage

The third stage was the development stage, which is media validity tests and limited trials conducted on students. The Draft I of the media website that had been designed was then validated by three validators consisting of two lecturers and one teacher from chemistry. At this stage, input and suggestions will be obtained from the validator and followed up with revisions to declare the resulting media valid.

Media Validity

The validation result scores were analyzed by determining the mode of the scores given by the three validators based on three aspects consisting of content, presentation, and language.

Table 6. Media Validity of Chemistry Learning Website

Aspect	Score			Mode	Category
	V1	V2	V3		
Content	4	4	4	4	Very Valid
Presentation	4	4	4	4	Very Valid
Language	4	4	4	4	Very Valid
	Validity Score			4	Very Valid

Based on Table 6 above, in the content aspect, the mode obtained from the score given was four, so media content was in a very valid category. Presentation and language aspects also get a mode of 4 so that presentation and language are placed in the "very valid" category. The chemistry learning website created was very valid because the overall score mode was four, so it was feasible for use in the limited trial phase.

Furthermore, a restricted trial was conducted to know the practicality and effectiveness of the website. The research instrument consisted of a student response questionnaire and student activity observation sheets to measure practicality and a pretest and posttest to measure effectiveness. The instrument used has been validated by the validator so that it is suitable for limited trials. The trial design used was the One Group Pretest Posttest Design with the trial pattern being carried out by giving an initial test (pretest), then given treatment in the form of learning using the chemistry learning website media then given a final test (posttest) and a student response questionnaire (Sugiyono, 2016). After the trial is complete, the researcher will analyze the resulting data.

Media Practicality

Media practicality was analyzed from the results of the practicality questionnaire filled in by students and observations of student activities.

Table 7. Recapitulation of Student Response Questionnaire Data

Aspect	Practical Percentage	Category
Content	95.10%	Very Practical
Presentation	96.47%	Very Practical
Graph	97.06%	Very Practical

Jurnal Paedagogy:
Jurnal Penelitian dan Pengembangan Pendidikan
https://e-journal.undikma.ac.id/index.php/pedagogy/index
Email: paedagogy@undikma.ac.id

Aspect	Practical Percentage	Category
Total Percentage	96.21%	Very Practical

Based on Table 7, the practicality percentage data obtained was 96.21%, with each aspect having a percentage of 95.10% for content, 96.47% for presentation, and 97.06% for graphics, which means the percentage obtained is ≥81% so that the media developed; namely, the chemistry learning website can be categorized as very practical.

Table 8. Recapitulation of Student Activity Observation Results

Student Activity	Activity Percentage	
	Meeting 1	Meeting 2
Relevant Activity	91.85%	90.74%
Irrelevant Activity	1.48%	0.37%
Total Percentage	93.33%	91.11%

From the data in Table 8, the percentage of relevant activities carried out by students during learning at meeting 1 was 91.85%, and at meeting 2 was 90.74%. The percentage of relevant activities obtained was ≥81%, so that the media can be categorized as very practical.

Media Effectiveness

After analyzing the practicality of the media, the next stage was to analyze the effectiveness of the website media obtained from the pretest and posttest data on students' cognitive and visual intelligence learning results. N-Gain analyzes the effectiveness and hypothesis testing previously carried out by the normality test. If the data has a normal distribution, use paired sample t-test; if the data are not distributed normally, use the Wilcoxon test.

Table 9. N-Gain Test

Test	Pretest	Posttest	N-Gain	Category
Cognitive	63,53	90,59	0,75	High
Visual Intelligence	57,35	87,35	0,73	High

Table 9 displays an N-Gain score of 0.75 for cognitive learning outcomes and 0.73 for visual intelligence. Scores equal to or greater than 0.7 are categorized as "high," suggesting that the website media was deemed effective in enhancing students' visual intelligence. The subsequent step involves subjecting the learning outcomes data to a normality test as a prerequisite for hypothesis testing.

Table 10. Data Normality Test of Cognitive Learning Outcomes (Top) and Visual Intelligence (Bottom)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.172	34	.012	.903	34	.005
Posttest	.264	34	.000	.835	34	.000

a. Lilliefors Significance Correction

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.201	34	.001	.843	34	.000
Posttest	.210	34	.001	.863	34	.001

a. Lilliefors Significance Correction

Based on Table 10, the Shapiro-Wilk test of normality was used. In the cognitive learning outcome data, the significance value obtained was 0.005 for the pretest and 0.000 for the

Jurnal Paedagogy:
Jurnal Penelitian dan Pengembangan Pendidikan
https://e-journal.undikma.ac.id/index.php/pedagogy/index
Email: paedagogy@undikma.ac.id

posttest. In the visual intelligence learning outcome data, the significance value obtained at the pretest was 0.000; at the posttest, it was 0.001. From the data in Table 10, it is found that the data on cognitive and visual intelligence learning results are not generally distributed due to the significant value being <0.05, so the hypothesis test used is the Wilcoxon test to find out the exists difference in the mean pretest and posttest learning outcomes of students.

Table 11. Wilcoxon Test Data on Cognitive Learning Outcomes (Left) and Visual Intelligence (Right)

Test Statistics[a]

	Posttest - Pretest
Z	5.130[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks

Test Statistics[a]

	Posttest - Pretest
Z	-5.186[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Based on the data in Table 11, on the Wilcoxon test, the significance value obtained was 0.000 on cognitive learning outcomes and 0.000 on visual intelligence learning outcomes. It is because the significance value obtained from these data was <0.05. The mean posttest results differ significantly from the mean pretest scores.

Based on the research results by Dwiningsih et al. (2023), the results of interactive multimedia development carried out were categorized as very valid, practical, and effective for increasing students' visual-spatial intelligence (Dwiningsih et al., 2023). It shows the same results as this study, so interactive media that visualize chemical representations can increase students' visual intelligence in learning chemistry. Based on other research by Huda & Dwiningsih (2021), the percentage of media validity obtained was 88.13% with a very valid category, the percentage of practicality obtained was 94% with a very practical category, the N-Gain score obtained was 0.708 with a high category, and the significance value obtained in the t-test was 0.000 so that the chemistry learning website media developed could improve student learning outcomes (Huda & Dwiningsih, 2021). It shows that one of the interactive media, namely the chemistry learning website developed by the researcher, obtained the same results as those conducted by Huda & Dwiningsih, so the chemistry learning website can be used as an alternative in choosing learning media to be able to improve student learning outcomes in chemistry learning.

Conclusion

The conclusions reached in the research show that the WordPress-based chemistry learning website media on chemical equilibrium material that has been developed is feasible to use and can help students practice visual intelligence so that it can improve cognitive learning outcomes and visual intelligence of students. That is because the chemistry learning website had a validity score of 4, with a very valid category. In addition, from the student response questionnaire, the media had practicality with a percentage of 96.21% and was categorized as very practical and measured by observing student activities with relevant activities at meeting 1 of 91.85% and meeting 2 of 90.74% so that the media can be said to be very practical. The effectiveness of the media was measured based on students' cognitive learning outcomes and visual intelligence, with the N-Gain value obtained on cognitive learning outcomes of 0.75 and visual intelligence learning outcomes of 0.73 with a high category so that the media website is said to be effective. Wilcoxon test results showed that cognitive learning outcomes

Vol. 10 No. 3 : July 2023
E-ISSN: 2722-4627
pp. 692-702

had a significance value of 0.000 and visual intelligence learning outcomes had a significance value of 0.000, indicating a significant variation between pretest and posttest results because of the significant value <0.05.

Recommendation

This research is only limited to the development stage, so it is suggested that the next researcher continues to the dissemination stage so that the developed website media may be directly used in the learning process in class and students' learning materials. For teachers, this chemistry learning website media can be used as a material option when learning chemical equilibrium material because it can be accessed directly through the website.

References

Almahfuz. (2021). Use of Conventional Based Learning Media and Information Technology by Teachers in Teaching and Learning Processes in Schools. *TANJAK: Journal of Education and Teaching*, *2*(1), 55–62. https://doi.org/10.35961/tanjak.v2i1.148

Dwiningsih, K., Widi Danielson, R., Damayanti, V., & Kurnia Lestari, P. (2023). Development of Interactive Multimedia to Improve Visuospatial Intelligence of High School Students Through the Three-Tier Test Strategy. *Jurnal Paedagogy*, *10*(2), 476–486. https://doi.org/10.33394/jp.v10i2.6744

Elu, A. M. (2013). Designing a Structured Query Language (SQL) Injection Vulnerability Detection Application for Website Security. *Scientific Journal of Information Technology*, *8*(22), 111–124.

Erlina, Hurrahman, M., Melati, H. A., Enawaty, E., & Sartika, R. P. (2022). Development of Multiple Representation-Based E-Modules with the Assistance of Augmented Reality Technology for Learning Molecular Shape Materials. *Journal of Indonesian Science Education*, *10*(1), 89–114. https://doi.org/10.24815/jpsi.v10i1.22579

Hasan, M., Milawati, Mp., Darodjat, Mp., & DrTuti Khairani Harahap, Ma. (2021). *Learning Media* (1st ed.). Tahta Media Group.

Hidayah, R., & Sugiarto, S. N. (2019). Validity of Students' Worksheet with The Mind Mapping Strategy on Chemical Bonding Material. *Unesa Journal of Chemical Education*, *8*(1), 121–125.

Huda, N., & Dwiningsih, K. (2021). Development of a Moodle-Based WordPress-Based Chemistry Learning Website to Improve Students' Learning Outcomes on The Elements Periodic System Material. *Journal of Chemistry Education and Learning*, *10*(3), 67–76. https://doi.org/10.23960/jppk.v10.i3.2021.08

Hulu, G., & Dwiningsih, K. (2021). The Effectiveness of LKPD Based on Blended Learning Assisted by Interactive Multimedia to Train Students' Visual Spatial. *Education: Journal of Education*, *19*(2), 319–333. https://doi.org/10.31571/edukasi.v19i2.2953

Kartini, S. K., & Putra, I. N. T. A. (2021). Development of Android-Based Interactive Learning Media on Hydrocarbon Material. *Journal of Chemistry Education Undiksha*, *5*(1), 37–43. https://ejournal.undiksha.ac.id/index.php/JJPK

Kristanto, A. (2016). *Learning Media*. Surabaya star publisher.

Lubis, I. R., & Ikhsan, J. (2015). Development of Android-Based Chemistry Learning Media to Increase Learning Motivation and Cognitive Achievement of High School Students. *IPA EDUCATIONAL INNOVATION JOURNAL*, *1*(2), 191–201.

Lutfi, A. (2021). *Research and Development (R&D) Implications in Chemistry Education*. Unesa University Press

Jurnal Paedagogy:
Jurnal Penelitian dan Pengembangan Pendidikan
https://e-journal.undikma.ac.id/index.php/pedagogy/index
Email: paedagogy@undikma.ac.id

Kemendikbud, Jakarta : Kementrian Pendidikan dan Kebudayaan (2013).

Pongkendek, J. J., & Kristyasari, M. L. (2022). Using Two Tier Multiple Choice for Student Misconception Analysis. *QUANTUM : Journal of Science Education Innovation*, *13*(1), 131–139.

Pratama, F. A., & Effendi, H. (2021). WordPress-Based E-Learning As An Alternative Learning Media. *Journal of Pedagogy and Learning*, *4*(3), 466–475. https://ejournal.undiksha.ac.id/index.php/JP2/index

Pratamadita, A., & Dwiningsih, K. (2021). Validity of Interactive E-module as a Learning Media to Train Spatial Visual Intelligence on Intermolecular Force Materials. *Proceedings of the National Seminar on Chemistry (SNK)*, 248–256.

Putri, R. D. (2020). Comparison of the Test Power of the Kolmogorov-Smirnov, Anderson-Darling, and Shapiro-Wilk Methods to test Data Normality. *Retrieved from Http://Repository.Usd.Ac.Id/Id/Eprint/36422*.

Rawung, W. H., Katuuk, D. A., Rotty, V. N. J., & Lengkong, J. S. J. (2021). Curriculum and Challenges in the 21st Century. *Journal Bahana of Education Management*, *10*(1), 29–34. https://doi.org/10.24036/jbmp.v10i1

Riduwan. (2015). *Basics of Statistics*. Alfabeta.

Rosmiati. (2022). Fun Chemical Learning in Madrasah. *Uniqbu Journal of Exact Sciences (UJES)*, *3*(1), 2723–3669.

Sari, A. A., Hadisaputro, S., & Nurhayati, S. (2017). Penerapan Inkuiri Terbimbing Berpendekatan Multiple Intelligences Terhadap Hasil Belajar Kimia. *Chemistry in Education*, *6*(2), 56–62. http://journal.unnes.ac.id/sju/index.php/chemined

Satriaman, K. T., Pujani, N. M., & Sarini, P. (2018). Implementation of the Student Centered Learning Approach in Science Learning and Its Relevance to Student Learning Outcomes in Class VIII of SMP Negeri 4 Singaraja. *Journal of Indonesian Science Education and Learning*, *1*(1), 12–22.

Sugiyono. (2016). *Educational Research Methods Quantitative, Qualitative, and R&D Approaches*. Alfabeta.

Sukarmin, & Sugiarti, F. (2019). Detecting and Reducing Misconception with Dered Misequilibri Software in Chemical Equilibrium. *Unesa Journal of Chemical Education*, *8*(1), 94–100

Sundayana, R. (2014). *Educational Research Statistics*. Alfabeta.

Sutarti, T., & Irawan, E. (2017). *Tips for Success in Receiving Development Research Grants*. Deepublish

Uno, H. B. (2016). *Theory of Motivation and Its Measurement*. PT Bumi Aksara.

Utari, D., Fadiawati, N., & Tania, L. (2017). Students' Representational Ability on Chemical Equilibrium Material Using Animation Based on Chemical Representation. *Journal of Chemistry Education and Learning*, *6*(3), 414–426.

Wati, W., & Novita, D. (2021). Reducing Misconceptions on Chemical Equilibrium Material through the Application of Predict Discuss Explain Observe Discuss Explain (Pdeode) Strategies. *Journal of Chemistry Education Undiksha*, *5*, 1–10. https://ejournal.undiksha.ac.id/index.php/JJPK

Wijaya, Y. Y., Sunardi, Slamin, Margaretha, P. M., & Wijayanti, N. P. A. A. (2019). Senior high school student's visual-spatial intelligence according to van hiele geometric thinking theory. *IOP Conference Series: Earth and Environmental Science*, *243*(1). https://doi.org/10.1088/1755-1315/243/1/012055

