# Developing an E-Student Worksheet Using Phenomenon-Based Learning for Reaction Rate Material on Wizer.me for Class XI High School/MA


## ABSTRACT

The aim of this research is to develop anE-Student Worksheet based on Phenomenon-Based Learning on Reaction Rate Material Using the Wizer.me websitefor Class XI Highschool/MA. The development of this E-Student worksheet was carried out because teachers have not used digital learning media and used the Phenomenon-based Learning model in their learning, especially in reaction rate materials. The Phenomenon-Based Learning approach is particularly significant for reaction rate materials because it can increase student engagement because learning is centered on real phenomena that are relevant to their lives.This development research uses the 4-D model, which consists of define, design, develop, and disseminate.However, this study was limited to the development stage.Data was collected through questionnaires, and interviews. Data analysis was carried out quantitatively, and qualitatively, guided by ideal evaluation criteria to determine the quality of the E-student worksheet. The research results show that the E-Student Worksheet that has been developed were declared valid in material validation in terms of content eligibility,characteristics of Phenomenon-Based Learning, language, presentation and graphics were 97.5%, 100%, 95%, 100% and 100% respectively. The results of media validation in terms ofE-Student Worksheet display and softwareusage are 100% and 100%. The results of the user response test obtained a percentage score of 92.41% by chemistry teachers with very good criteria and 89.51% by students with very good criteria, which indicates that this E-student worksheet is valid and suitable for use as analternative teaching material in the learning process, and it is hoped that this research can be continued in the next stage.



***Keywords****: Reaction Rate, E-Student Worksheet, Phenomenon Based Learning,*Digital learning


## 1. INTRODUCTION

The swift advancement of technology in today's global landscape has become deeply intertwined with the education sector. As global demands evolve, the educational system must continuously adapt to these technological changes in order to enhance the quality of education. This necessitates specific adjustments, particularly in the integration of information and communication technology into the learning process[1]. In order for learning to keep up with technological developments and students to be able to compete in a globalized world, it is expected to be able to use equipment digitally. The benefits of digital learning in supporting the implementation of the learning process are toincrease students' absorption in understanding the context of learning materials, to promote independent learning skills, to increase students' active participation, and to increase the ability to present information using technological devices to develop learning skills [2].

Anefforttoimprove the quality of educationtodayis the IndependentCurriculum[3]. Theindependentcurriculumisanewpolicymadeby the MinistryofEducationandCultureoftheRepublicofIndonesia.Theindependentcurriculuminitsimplementation is fullysupportedbylearningtoolsthatmakestudentsactive,oneofwhichis the StudentWorksheet[4].Student Worksheetisameanstohelpstudentsdevelopactivelearning,beable to establisheffectiveinteractionbetweenteachersandstudents,andimprove their abilitytosolveproblemswithcreativethinking[5]Student Worksheetcanalsoactivatelearningindependenceinstudentswiththehelp of learningmodelssuchasthephenomenonbasedlearningmodel.

Phenomenon-based learning was first implemented in Finland in 2016 as a curriculum by requiring teachers to teach based on a phenomenon-based learning approach that utilizes the out-of-school environment and innovative technology to increase students' involvement, interest, and activeness in learningthat centers on real-world phenomena encountered in everyday life. In this model, students take an active role in exploring and understanding these phenomena while also addressing the associated challenges.[6].Phenomenon-based learning starts with observation of a phenomenon from different points of view.According to Silander[7]the phenomenon-based approach in teaching and learning starts from constructivism and includes elements of social-cultural learning. Phenomenon-based learning consists of five dimensions: holisticity, authenticity, contextuality, problem-based inquiry learning and learning process. Depending on how the specific approach is implemented in a classroom, the results can range from a superficial study of the phenomena with limited evidence to a more advanced application of learning [7].

The results of interviews with chemistry teachers from SMA N 15 Pekanbaru and SMA N 9 Pekanbaru, found that both schools have used the independent curriculum, but have never used student worksheet which is developed digitally and with a learning model, especially the phenomenon based learning model in reaction rate material as a learning resource.And students are allowed to bring and use electronic devices such as cellphones or laptops during learning. One alternative to overcome these problems is to combine the Phenomenon Based Learning model with E-Student Worksheet or electronic student worksheet in order to develop students' thinking skills and the formation of interactive learning. Phenomenon-based learning can increase student engagement because learning is centered on real phenomena that are relevant to their lives. By observing phenomena related to reaction rates, such as color or temperature changes, students are more motivated to investigate and understand more abstract chemical concepts [8].

The use of E-Student Worksheet in education is urgently needed because sophisticated technology demands to utilize teaching materials in digital form and utilize media to provide real experiences to students so that learning is more effective [9]. There are many types of E-Student Worksheet that can make students learn interactively, one of which is by using the Wizer.me website. The Wizer.me website has several advantages, namely that Student Worksheet can be easily accessed using any electronic device such as a smartphone or laptop, Student Worksheet is also attractively packaged because it is supported by the format that has been provided wizer.me, the question features provided are also varied and can be used according to the needs of teachers[10].

The use of the Phenomenon Based Learning Model on the Reaction Rate material using the Wizer.me website is supported by research conducted by Abdullah et. al[11]with the title "Validity and Practicality of E-Module Based on Phenomenon Based Learning Using Articulate Storyline on Material Colligative Properties of Solutions", and research conducted by Arsyisyah et. al [12] in 2023, namely " "Development of E-LKPD Thermochemistry Based on Self Regulated Learning (SRL) Using Wizer.Me in Class XI High School/MA Equivalent ".

## 2. METHODOLOGY:

The type of research used is research and development, which is a type of research that aims to develop a product that begins with needs research and then development is carried out to produce a valid product.

The model of development that is used as a reference in this study is the 4D model (Four D), which is one of the development models that is suitable for developing a product[13].The developed product undergoes feasibility testing to validate its effectiveness. This process is structured into four stages: Define, Design, Develop, and Disseminate. However, this research concluded after the Develop stage, without advancing to Disseminate because the purpose of this study is only to see the validity of the E-Student Worksheet that has been developed and to see the response of users (teachers and students).

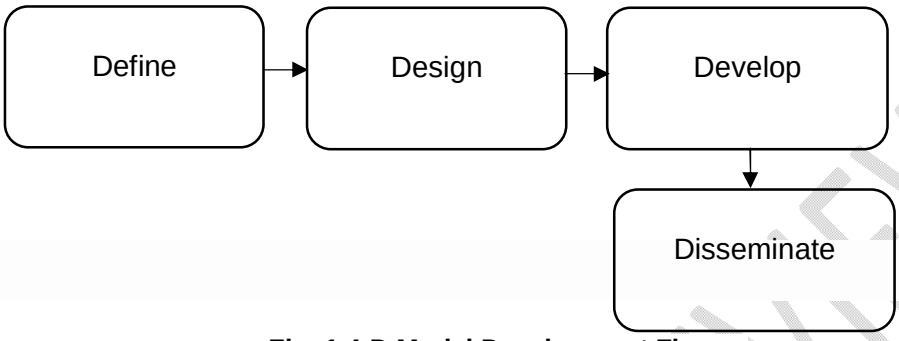


**Fig. 1 4-D Model Development Flow**

**Table 1. Phases of Phenomenon-Based Learning**

| Phase | Teacher Activities | Student Activities |
|---|---|---|
| Orientation of students to phenomena | The teacher gives examples of phenomena related to the rate of reaction in the form of articles or videos to students. | Students read and understand the content of the article/video about the given phenomenon. |
| Organizing learners to learn | Teachers help students to analyze problems and organize tasks related to problems from phenomena. | Students analyze problems and prepare to receive learning assignments related to problems from phenomena. |
| Assisting in group or individual investigations | Teachers encourage students to get the right information, carry out experiments, and find explanations and solutions. | Students collect information, behave according to experiments, look for explanations and solutions. |
| Developing and presenting works | Teachers help students in planning and preparing the right work, such as reports, video recordings, and help them convey it to others. | Students plan and prepare work and share the work with other students. |
| Analyze and evaluate the | Teachers help students to reflect on their | Learners reflect on the research and processes |

| | |
|---|---|
| problem-solving process | investigations and the used. processes they use |

*Source: Symeonidis, V & Schwarz, J., 2016* [14]

## 2.1. Method of Qualitative Analysis

Qualitative data were obtained from interviews with grade XI chemistry teachers of SMAN 9 Pekanbaru and SMAN 15 Pekanbaru, inputs, responses, and criticisms from material expert validators and media expert validators, and user responses.

## 2.2. Method of Quantitative Analysis

QuantitativedataintheformofscoresforeachassessmentindicatorontheE-Student Worksheetvalidationinstrumentbased on the PhenoBLlearningmodelon the ReactionRatematerialwiththeWizer.mewebsiteforClassXIHighSchool/MAequivalentwhichiscompletedby material expertvalidatorsandmediaexpertvalidators.Theevaluationofeachindicatorobtainedisthenconvertedintoascorewithalikertscaletoobtainthecriteriaandvalidityleveloftheе-Student Worksheetbasedon the Phenomenon-BasedLearninglearningmodelon the ReactionRatematerialwiththeWizer.mewebsiteforClassXIHighSchool/MAEquivalentdevelopedand a producttrialquestionnairefilledoutbyteachersandstudentsfromSMAN9PekanbaruandSMAN15Pekanbaruwhohavestudied the reactionratematerial.The results of the teacher and student response questionnaires are then classified based on practicality criteria.

### 2.2.1. Development Product Validity Analysis

Analysis of the validity of the E-Student Worksheet based on phenomenon-based learning as a teaching material for high school chemistry learning grade XI on the reaction rate material to the feasibility of the content, the linguistic aspect, the presentation aspect, and the graphic aspect.

**Table 2. Validator Assesment Category**

| Assesment Score | Category |
|---|---|
| 4 | SS: Very Good |
| 3 | S: Good |
| 2 | KS: Less Good |
| 1 | TS: Not Good |

*Source: Sugiyono, 2021*[15]

The validation results are calculated by the average score formula, which is by the equation:

$$\text{Percentage} = \frac{Score\ Obtained}{Maximum\ Score} \times 100\%$$

Then the results of the validation sheet percentage were converted according to the scale evaluation criteria to make a decision on the quality of the E-Student Worksheet based on the Phenomenon-Based Learning learning model on the reaction rate material using the wizer.me website for ClassXI High School/MA. Performance level conversion as shown in Table 2.

**Table 3. Validator Assement**

| Percentage | Criteria |
|---|---|
| 80,00-100 | Good/Valid/Decent |
| 60,00-79,00 | Good Enough/ Valid Enough/ Decent Enough |
| 50,00-59,99 | LessGood/Less Valid/LessDecent |
| 0-49,00 | NotGood/NotValid |

*Source: Riduwan, 2012*[16]

### 2.2.2. User Response

Teacher's Response

The teacher response questionnaire is structured as a checklist utilizing the Likert scale. Each item prompts a response based on an alternative positive attitude statement, which can range from very positive to very negative. To quantify these responses, the alternative positive attitude statements are assigned scores based on a four-point Likert scale, as illustrated in Table 2.

The results of thealternative data on positive statements about teachers' attitudes are calculated using the mean score formula, which is given by the equation:

$$\text{Percentage} = \frac{Score\ Obtained}{Maximum\ Score} \text{ x } 100\%$$

Then the results of alternative data on positive questions of teacher attitudes were converted according to the scale evaluation criteria to make decisions about the quality of E-student worksheet based on the Phenomenon-Based Learning model on the reaction rate material using the wizer.me website. Performance level conversion as shown in Table 4.

**Table 4. Teacher's Response Assesment Criteria**

| Percentage | Criteria |
|---|---|
| 80,00-100 | Good |
| 60,00-79,00 | Good Enough |
| 50,00-59,99 | LessGood |
| 0-49,00 | NotGood |

*Source: Sugiyono, 2021*[15]

Student's Response

The student response questionnaire utilized a Likert scale presented as a checklist (√). Each item on the instrument was designed to assess attitudes through an alternative positive statement, ranging from very positive to very negative. These statements were then converted into scores using a 1-4 Likert scale, as illustrated in Table 2.

Then the results of the alternative data on positive questions of students' attitudes were converted according to the scale scoring criteria to make decisions about the quality of the E-Student Worksheet based on the Phenomenon-Based Learning model on the reaction rate material using the wizer.me website. The perfomance level conversions are shown in Table 4.

## 3. RESULTS AND DISCUSSION

### 3.1. Result

The research conducted has resulted in a product in the form of E-Student Worksheet Based on Phenomenon Based Learning on Reaction Rate Material Using the Wizer.me Website for Class XI High School/MA Equivalent. This research employed the Research and Development (R&D) methodology alongside the 4-D model, which encompasses defining, designing, developing, and disseminating. The study was conducted up to the development phase, where an expert validation was carried out to assess the feasibility of the E-Student Worksheet. Following this, one-on-one testing and user response evaluations were conducted with both students and teachers.

### 3.1.1. Define

In this Define step, information about needs is obtained from four main steps, namely front-end analysis, concept analysis, task analysis, and formulation of dissemination objectives.

### 3.1.2. Design

This designphase resulted in the initial design of an E-Student Worksheet based on the PhenoBL learning model using the Wizer.me website.

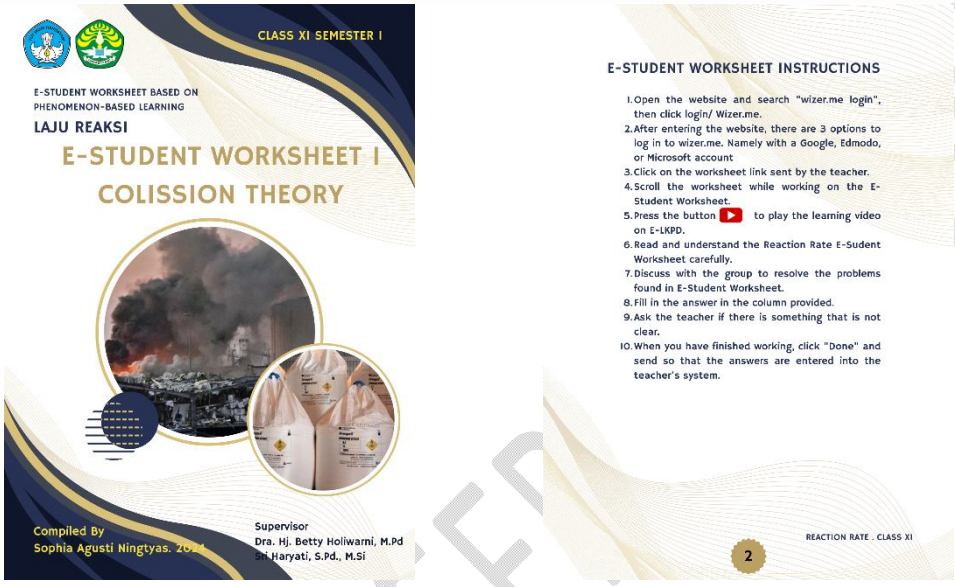


**Fig. 2 E-Student Worksheet Design**

The first draft of the E-Student Worksheet contains components that include a cover page with the title and identity of the E-Student Worksheet, CP and TP, instructions for using the E-Student Worksheet, the contents of the E-Student Worksheet, learning materials, and a bibliography. In addition, the initial design also includes research tools that include materials and media expert validation sheets, teacher response questionnaires and student response questionnaires.

**Table 5. Guidebook for the implmentation of Phenomenon-based Learning models**

| Components | Content |
|---|---|
| E-Student Worksheet 1 | Collision Theory |
| E-Student Worksheet 2 | Factors that affect the reaction rate |
| E-Student Worksheet 3 | Reaction Rate Practicum |
| E-Student Worksheet 4 | Equation of Rate and Order of Reaction |

### 3.1.3. Develop

The develop E-Student Worksheet has been validated and tested to a limited extent. The result of the development phase of the E-Student Worksheetare described below:

**1. Validation of E-student Worksheet**

The validation produced quantitative data (Likert scale), which was then calculated as an average percentage, so that qualitative data was produced in the form of categories from the E-student worksheet, which was developed to consist of valid, moderately valid, less valid and invalid categories[13].

**Table 6. Recapitulation of Material Validation Results**

| Eligibility Aspects | Validation I (%) | Information | Validation II (%) | Information |
|---|---|---|---|---|
| **Aspects of Content** | 85% | Valid | 97,5% | Valid |
| **Aspects of *Phenomenon Based Learning*** | 87,5% | Valid | 100% | Valid |
| **Aspects of Serving** | 80% | Valid | 95% | Valid |
| **Aspects Language** | 66,6% | Valid Enough | 100% | Valid |
| **Graphics** | 87,5% | Valid | 100% | Valid |

*Source: Research Data, Processed 2024*

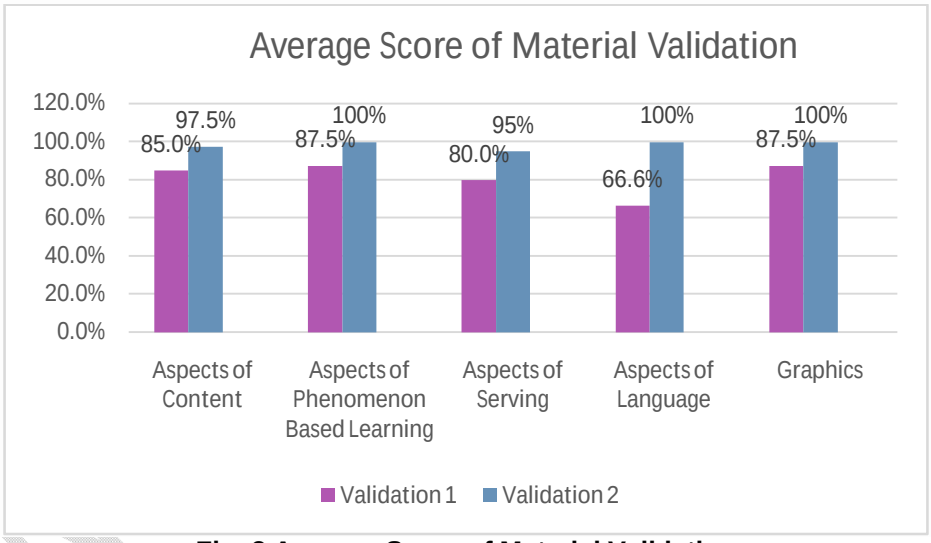


**Fig. 3 Average Score of Material Validation**

**Table 7. Recapitulation of Media Validation Results**

| Eligibility Aspects | Validation I (%) | Information | Validation II (%) | Information |
|---|---|---|---|---|
| **Aspects of Display (Visual Communication)** | 88,8% | Valid | 100% | Valid |
| **Aspects of Software Utilization** | 100% | Valid | 100% | Valid |

*Source: Research Data, Processed 2024*

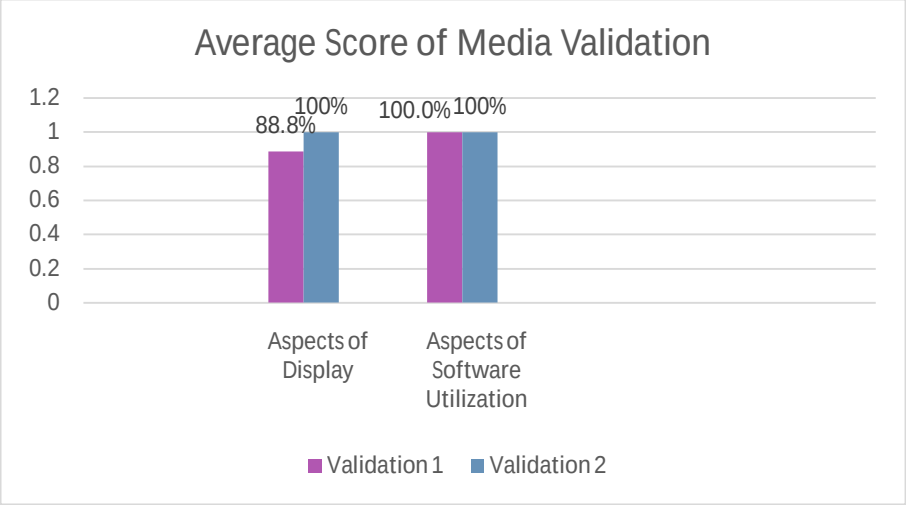


**FIGURE 4.** Average Score of Media Validation

The results of validation by the material validator based on the feasibility of the content were obtained with a score percentage of 97.5%, the feasibility of *Phenomenon Based Learning* characteristics of 100%, the feasibility of presentation of 95%, the feasibility of language of 100%, and the feasibility of graphics of 100% with valid/feasible criteria. The results of validation by media validators based on the feasibility aspect of the E-LKPD display were obtained with a score percentage of 100% and the software utilization aspect of 100% with valid/feasible criteria. This shows that the late E-Student Worksheet is valid and feasible to be used in learning, especially in reaction rate materials.

**2. User Response**

The user response test consists of a teacher response test, a student response test, and a one-on-one test. Teacher response tests were conducted on 2 teachers from SMAN 15 and SMAN 9 Pekanbaru, student response tests were conducted on 20 students from SMAN 15 Pekanbaru and SMAN 9 Pekanbaru, and one-on-one tests were conducted on 3 students from SMAN 15 Pekanbaru.

**Table 8. Recapitulation of Teacher Response Result**

| Eligibity Aspects | Average Percentage (%) | Information |
|---|---|---|
| Content | 95,83% | Very Good |
| Aspects of *Phenomenon Based Learning* | 97,5% | Very Good |
| Ease of Use | 87,5% | Very Good |
| Benefit of Use | 93,75% | Very Good |
| Attractiveness of Presentation | 87,5% | Very Good |
| **Average Overall Percentage** | **92,41%** | **Very Good** |

*Source: Research Data, Processed 2024*

**Table 9. Recapitulation of Student Response Result**

| Eligibility Aspects | SMA N 15 Pekanbaru | SMA N 9 Pekanbaru | Overall Average Percentage (%) | Information |
|---|---|---|---|---|
| Ease of Use | 88,75% | 90% | 89,37% | Very Good |
| Benefits of Use | 84,5% | 90,5% | 87,5% | Very Good |
| Attractiveness of Presentation | 89,58 | 93,75% | 91,66% | Very Good |
| **Average Overall Percentage (%)** | | | **89,51%** | **Very Good** |

*Source: Research Data, Processed 2024*

The user response of 2 chemistry teachers to the E-Student has met the aspects of content feasibility, phenomenon based learning characteristics, ease of use, benefits of use, and attractiveness of presentation by obtaining a score percentage of 92.41% with very good criteria. The results of user responses by 20 students to E-Student Worksheet were stated to have met the aspects of ease of use, benefits of use, and attractiveness of presentation by obtaining a score percentage of 89.51% with the very good category.

### 3.2. Discussion

#### 3.2.1. Validation of E-Student Worksheet

A product is said to be good/feasible if it meets quality criteria, including validity, practicality, and effectiveness [17]. The developed E-Student Worksheet will be tested for validity by 3 expert validators, namely 2 material expert validators and 1 media expert validator. The developed productwill be declared valid if the product has been validated and has received valid criteria.

The material validation process by material experts is carried out 2 times for each validator. In the validation of the material, there are 5 aspects of feasibility are assessed, namely the feasibility of content, the feasibility of phenomenon-based learning characteristics, the feasibility of presentation, the feasibility of language, and feasibility of graphics. These five aspects has been developed into 20 statements. Materials experts provide comments and suggestions to improve the E-Student Worksheet so that it is suitable for learning. The results of material validation in terms of content aspects of content, aspects of phenomenon-based learning aspects, presentation aspects, language aspects, and graphics were 97.5%, 100%, 95%, 100% and 100% respectively.

There are 2 aspects of feasibility assessed by the media expert validators, namely the feasibility of display (visual communication) and the feasibility of using software. These two aspects were developed into 14 statements. The media validation process by media experts is carried out 2 times. Themedia experts provide comments and suggestions to improve the E-student worksheet so that it is suitable for learning. The results of media validation from the display aspect, and the software use aspect are 100%, and 100% respectively.

#### 3.2.2. User Response

An educational resource, including E-Student Worksheet, is considered well-designed when it fulfills effectiveness criteria[17]. E-Student Worksheet is deemed effective if students demonstrate success in their learning journey and if there is alignment in the curriculum regarding their learning experiences and achievement of outcomes. Furthermore, a development product is regarded as practical when it is user-friendly for both students and teachers, offering more comprehensive content than standard textbooks[17]. Ibrahim &Subali[18]. emphasized that the practicality of a development product can be assessed by observing the ease or difficulty users encounter when utilizing the product. To evaluate both

effectiveness and practicality, user response tests were conducted with teachers and students, along with one-on-one assessments.

The experiment, E-Student Worksheet was conducted in 2 schools, namely SMA N 15 Pekanbaru and SMA N 9 Pekanbaru. The experiment was conducted in 3 sessions using E-LKPD based on the Phenomenon Based Learning (PhenoBL) learning model on reaction rate materials using the Wizer.me website. The trial activities carried out are teacher response tests, student response tests and one-on-one trials.

The teacher response test was carried out by providing a link to an E-student worksheet based on the Phenomenon-based learning model on the reaction rate material using the Wizer.me website and also given in printed form. The teacher sees and pays attention to the given E-student worksheet and then evaluates the E-student worksheet based on the teacher's evaluation sheet on the given E-student worksheet. The results of the teacher response test were very positive and in line with the validation results on the aspects of content suitability, characteristics of phenomenon-based learning, presentation, grammar, and graphics. There was a small suggestion for the 2nd E-student worksheet in the discourse section of Activity 3, but according to the teacher for the overall E-student worksheet was very good, as evidenced by the response result of 92.41% with very good criteria.

The student response test was conducted with 20 students. 10 students from SMA N 15 Pekanbaru and 10 students from SMA N 9 Pekanbaru. Before providing an access link to E-student worksheet based on the phenomenon-based learning model on the reaction rate material using the Wizer.me website, the researcher first explained the researcher's intentions and objectives to the students. The researcher also gave a brief explanation of the E-student worksheet based on the phenomenon-based learning model on the reaction rate material using the Wizer.me website. The student response questionnaire is given after the student has finished working on the E-student worksheet, with the assessment component according to the questionnaire grid.

The result of the student response test was that the students found that the E-student worksheet was easy to use, understandable, could provide knowledge and the students expressed interest in using the E-student worksheet as a learning resource/book at school or at home. Students are also active in the experiment carried out. The evaluation of the students' responses was obtained at 89.51% with very good criteria.

The one-on-one testing stage involved three students from SMA N 15 Pekanbaru with different cognitive abilities. The implementation of this stage aims to identify errors/shortcomings/weaknesses of E-student worksheet when used by students. Student feedback on E-student worksheet, students said that E-student worksheet is practical and very easy to use, the material in E-student worksheet is clearly explained and there are learning videos to help students find information.

However, there are a some obstacles in working on the E-student worksheet using an Android mobile phone, the size of the display on the E-student worksheet does not match the mobile phone screen but this can be overcome by changing the screen from portrait to landscape. Then the students also said that the activities/questions in the 2nd E-student worksheet regarding the factors that affect the reaction rate are too much, this is a consideration for the researcher to reduce the number of questions in the E-student worksheet.

Based on the results of the user response questionnaire (teachers and students), it can be concluded that the development E-Student Worksheet meets the criteria of effectiveness and practicality according to Nieveen[17].

## 4. CONCLUSION

The results of the research on the Developingof an E-Student Worksheet based on the Phenomenon-Based LearningModel on Reaction RateMaterials using the Wizer.meWebsite for Class XI High School/MAwere declared valid based on the results of material and media validation. The results of material validation in terms of content suitability,Phenomenon-Based Learningcharacteristics, language,

presentation and graphics were 97.5%, 100%, 95%, 100%, and 100% respectively. The results of media validation in terms of E-Student Worksheet display and softwareusage are 100% and 100%. The results of the user response test were 92.41% for chemistry teachers with very good criteria and 89.51% for students with very good criteria**,** which indicates that this E-student worksheet is valid and suitable for use as an alternative teaching material in the learning process, and it is hoped that this research can be continued in the next stagefor sharing the developed E-Student Worksheet with a wider audience and exploring its implementation in diverse educational settings.

**Disclaimer (Artificial intelligence)**

Authorshavedeclared that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**REFERENCES**

# References


[1] E. Nurillahwaty, "Peran Teknologi Dalam Dunia Pendidikan," in *Seminar Nasional Pendidikan*, 2021.

[2] A. Marpaung, Z. Muchtar and N. Nurfajirani, "Development of e-LKPD Assisted by Liveworksheets Based on HOTS in Chemistry Materials of Grade X Senior High School Even Semester of Merdeka Curriculum," in *AISTEEL*, Medan, 2023.

[3] E. Zumrotun, E. Widyastuti, Sutama, A. Sutopo and B. Murtiyasa, "Peran Kurikulum Merdeka dalam Meningkatkan Mutu Pendidikan di Sekolah Dasar," *Jurnal Karya Ilmiah Guru,* vol. 9, pp. 1003-1009, 2023.

[4] M. Suryaman, "Pengembangan Kurikulum Merdeka Belajar Program Studi Pendidikan Bahasa Indonesia," in *Seminar Daring Nasional*, 2020.

[5] Suarni, "Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Discovery Based Learning (DBL) Dilengkapi Soal Higher Order Thinking Skills (HOTS) Peserta Didik Kelas XIMAN Kota Sorong," *Jurnal Inovasi Pendidikan dan Pengajaran,* vol. 2, pp. 52-66, 2022.

[6] K. Wakil, R. Rahman, D. Hasan, P. Mahmood and T. Jalal, "Phenomenon-Based Learning for Teaching ICT Subject through other Subjects in Primary Schools," *Journal of Computer and Education Research,* vol. 7, pp. 205-212, 2019.

[7] P. Silander, Digital Pedagogy, Oulu: University of Oulu, 2015.

[8] K. Heinrichs and M. Moser, "Phenomenon-based learning: Enhancing student engagement in science," *Journal of Science Education,* vol. 43, pp. 123-145, 2019.

[9] S. Amtonis, "E-LKPD Dan Literasi Lingkungan Pada Pendidikan Era Revolusi Industri 4.0," *Jurnal Koulutus,* vol. 5, pp. 72-80, 2022.

[10] I. Sulastri, N. Mahardika, P. Sugiarti and Y. Sudrajat, "Analisis hasil belajar dalam penggunaan lembar kerja peserta didik (LKPD) Interaktif dengan Aplikasi Wizer.Me Materi Interaksi Sosial," *Jurnal Ilmiah Pendidikan dan Pembelajaran,* vol. 2, pp. 57-62, 2023.

[11] Abdullah, Herdini and T. S. Putri, "Validity and Practicality of E-Module Based on Phenomenon Based Learning Using Articulate Storyline on Material Colligative Properties of Solutions," *Jurnal Penelitian Pendidikan MIPA,* vol. 10, pp. 764-775, 2024.

[12] Arsyisyah, Rasmiwetti and S. Haryati, "Development of E-LKPD Thermochemistry Based on Self Regulated Learning (SRL) Using Wizer.Me in Class XI High School/MA Equivalent," *Journal of Research and Education Chemistry,* vol. 5, p. 74, 2023.

[13] A. Harjanto, A. Rustandi and J. Caroline, "Implementasi Model Pengembangan 4D Dalam Mengembangkan Media Pembelajaran Berbasi Online Pada Mata Pelajaran Pemrograman Web di SMK Negeri 7 Samarinda," *Junral SIMADA (Sistem Informasi dan Manajemen Basis Data),* vol. 5, pp. 1-12, 2022.

[14] V. Symeonidis and J. Schwarz, "Phenomenon-Based Teaching and Learning through the Pedagogical Lenses of Phenomenology," in *Forum Oswiatowe*, 2017.

[15] Sugioyono, Metode Penelitian Kuantitatif, Kualitatif dan R&D, Alfabeta, 2021.

[16] Riduwan, Skala Pengukuran Variable-Variable Penelitian, Alfabeta, 2018.

[17] N. Nieveen, "Prototyping to reach product quality," in *Design Approaches and Tools in Education Training*, London, Kluwer, 1999, pp. 125-135.

[18] Ibrahim and Subali, "Pengembangan Bahan Ajar & Pengembangan Instrumen Pengukuran Pembelajaran Biologi," in *Workshop Pendidikan Biologi*, 2017.