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Designing POGIL Based Student Worksheets for Buffer Solution Learning at SMAN 2 Sawahlunto

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Abstract
The purpose of this study was to produce a valid and practical Process Oriented Guided Inquiry Learning (POGIL)-based Student Worksheet (LKPD) on 11th Grade Class Buffer Solution Material at State Senior High School (SMAN) 2 Sawahlunto. This research uses the Research and Development research method with the 4-D development model (define, design, develop, and disseminate). However, the stages in research with this 4-D model are only carried out from the first to the third stage, namely the define stage aims to get an overview of field conditions, the design stage aims to compile and design POGIL-based Student Worksheets (LKPD) on buffer solution material, and the develop stage aims to continue the POGIL-based LKPD on buffer solution material that has been designed with validity and practicality tests. The research instruments used were validation sheets and response questionnaire sheets. The validation sheet was filled by 2 lecturers and 1 chemistry educator. The response questionnaire sheet was filled by 25 of 11th grade students and 2 chemistry educators of SMAN 2 Sawahlunto. The results showed that 1) POGIL-based LKPD on buffer solution material meets the valid criteria with 85.42% validation results. 2) POGIL-based LKPD on buffer solution material has met the practical criteria with educator practicality response questionnaire results of 92.31% and student response questionnaire results of 82.15%.

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INTRODUCTION

The development of science, technology and communication in the 21st century opens up opportunities to improve the implementation of quality education. Along with the development of all fields, the field of education has also undergone a change. The change in question is the change in the use of curriculum in the learning process. The latest curriculum change initiated by the Ministry of Education, Culture, Research and Technology is an independent curriculum with an independent learning program that is expected to improve the quality of learning, where the independent curriculum offers three characteristics including project-based learning, soft skills and character development in accordance with the Pancasila student profile, learning on essential materials and a more flexible curriculum structure (Pratiwi & Luh Indrayani, 2023).

The implementation of this independent curriculum has not been used simultaneously in all schools in Indonesia, but rather some of the existing driving schools are appointed to conduct trials using the independent curriculum, including State Senior High School (SMAN) 2 Sawahlunto. Based on an interview with one of the one of the teachers at SMAN 2 Sawahlunto, information was obtained that implementation of the independent curriculum at school is still relatively new and is still in the learning and adaptation stage learning and adaptation stage. The implementation of the independent curriculum at school follows instructions and directions from the government with learning in general and project-based learning for softskill development. In project-based learning, the government sets a theme in the form of a pencasila student profile, so that every school that implements this curriculum can freely choose the right theme and adapt it to the conditions of the school (Teachers et al., 2024).

Meanwhile, in the application of the independent curriculum in chemistry learning, according to the teacher of chemistry 11^{th} Grade class at SMAN 2 Sawahlunto, information was obtained that this curriculum applies diverse learning and races with the material that must be mastered and understood by students. Chemistry lessons in high school contain many concepts that are quite difficult for students to understand, because it involves chemical reactions, calculations and many concepts that are abstract (Nadila & Mawarnis, 2023). Buffer solution is one of the chemistry materials that is considered difficult and absract. Buffer solution is material that has characteristics that involve chemical reaction mechanisms, and calculations that involve various stages and contextual material (Halimah et al., 2019). Buffer solution material is considered difficult because it is complex and applies a lot of mathematical calculations (Musafir et al., 2021).

In the implementation of chemistry learning in the classroom, the use of learning models and methods applied by teachers in chemistry learning is discovery learning and lecture, question and answer, and discussion methods. However, in reality, the lecture method dominates so that students involved in learning become less active because learning becomes centered on educators. In addition, the chemistry teacher also explained that there is no effective teaching material that can support chemistry learning in this curriculum. In learning, educators only share power points and chemistry e-modules from the Ministry of Education and Culture as supporting teaching materials and the old 2013 curriculum package book as the main teaching material during the learning activity process.

Chemistry learning activities are also still focused on educators (teacher center) and the lack of variety of teaching materials used by educators in the learning process so that students are bored and have an impact on the teaching and learning process that is less effective because the teaching materials used are not able to foster motivation and interest in learning students. This causes students to be less active in learning and tend to be passive in answering questions given by educators and also has an impact on student learning outcomes.

In addition to interviewing educators, researchers also conducted interviews with 11^{th} grade students of SMAN 2 Sawahlunto. Students explained that related to teaching materials and media used by educators in learning is still lacking to make them able to understand the concept of chemical material. In learning, students also find it difficult to use chemical formulas with different problems because they have not mastered the chemical concepts. Students also argue that learning using textbooks, is less interesting, boring and quite monotonous so that students tend to utilize answers from peers to answer problems given by educators without understanding the concept of the learning material. The impact of this results in the low learning outcomes of students who do not achieve the Learning Objective Achievement Indicator (IKTP) with the criteria for achieving learning objectives (KKTP) with a score of 75 still cannot be achieved by students on the daily tests of students in 11^{th} grade class on F phase. The results of the daily tests of students in buffer solution material are shown in Table 1.

Table 1. Student Test Results

Class	Number of Students			Percentage	
	Total Students	Completely	Not	Completely	Not
11th grade Chemistry 1	32	11	21	34%	66%
11th grade Chemistry 2	32	13	19	41%	59%
11th grade Chemistry 3	32	15	17	47%	53%

(Source: Chemistry Subject Teacher of SMAN 2 Sawahlunto)

The independent curriculum in its application requires teaching materials that can make students active in learning, one of which is LKPD (Student Worksheet). According to Kosasih (2021)LKPD is teaching material in the form of work sheets or learning activities for students. Meanwhile, according to Nadien & Kurniawati, (2024) LKPD is a means to assist students in developing active learning, can establish effective interactions between teachers and students, and improve the ability to solve problems by thinking creatively. LKPD is used by teachers to make it easier to achieve learning objectives and convey concepts well to students (Herpadora Yulika & Hardeli, 2023). In addition, LKPD can also train students in the discovery and development of their skills through group discussion activities, practicum, and activities to answer problems related to everyday life. Students become more challenged in the learning process and can have an impact on improving their way of thinking including critical thinking. Prastowo (2012) in Khasanah & Fadila, (2018) also argues that the function of LKPD is to make students more independent to understand the material, this is in line with one of the dimensions in the Pancasila Student Profile in the Merdeka Curriculum.

The application of LKPD in the learning process without using a learning model will not produce efficient results and studying buffer solutions should be taught using an appropriate learning model so that students do not experience difficulties in learning it and students can relate directly to various useful objects around students' lives (Andriani & Ayu Dewi, 2017). One of the learning models that can be applied to LKPD is the Process Oriented Guided Inquiry Learning (POGIL) learning model. The Process Oriented Guided Inquiry Learning (POGIL) learning model was created with the aim of increasing student involvement so that they become the main focus of learning and can develop their own thinking skills to solve problems. The model consists of 5 stages and each stage provides advantages for students including better organization, order, and guidance in the learning process. It aims to achieve learning objectives and utilize time effectively (Erna et al., 2018).

In the concept formation phase of the POGIL learning process, the teacher as a facilitator asks questions to help students think critically. The questions asked direct students to identify concepts and understand the concepts that are built. According to Adelia Alfama Zamista, (2015) the POGIL learning model is divided into 5 stages, namely: 1) orientation, 2) exploration, 3) concept discovery, 4) application and 5) closing. In the orientation stage, students are given a stimulus or an illustration that can prepare students to learn. In POGIL learning, the stimulus can also be in the form of questions given by the teacher or in the form of questions contained in the LKPD. The question directs students to observe things that are considered interesting or important so that the facts, concepts, skills, or principles that are the target of the learning can be found. In addition, POGIL model learning requires students to be actively involved to work together in small groups and allows the group to get guidance from the teacher if they find difficulties in exploration (guided inquiry) (Rosidah, 2013).

The application of the POGIL model encourages active student involvement in classroom learning. By actively involving students in the chemistry learning process, it is expected that student learning outcomes can improve. The POGIL model involves several stages, such as exploration and concept discovery, where students are expected to recognize and process the information they obtain, so that they can find the concept in question. The use of the POGIL model in learning has been proven effective in improving student learning outcomes in the cognitive domain (Aulia et al., 2018). Research conducted by Akmalia et al., (2019) supports these findings, stating that student learning outcomes increase positively when the learning process uses the POGIL model. The advantages of this POGIL learning model include being able to guide students to discover knowledge independently and can be applied at all levels of education. The application of this model can also help students improve process skills, questioning skills, and communication skills (Malik et al., 2017).

METHOD

The type of research used is the development research method or commonly known as Research and Development (R&D) with the 4D development model. The development research method is a research method used to produce certain products and test the effectiveness of the developed products. The 4D development model developed by Thiagarajan (1974) consists of four 4-D stages, namely define, design, develop and disseminate (Ilahi et al., 2023). The data collection instruments used were interviews, validity tests and practicality tests. Validity and practicality tests were conducted by distributing questionnaires, this aims to measure the validity and practicality of the products developed (Ulfa Mutia, 2024). The Process Oriented Guided Inquiry Learning (POGIL)-based Student Worksheet (LKPD) was developed by applying the 4-D development model. In this study, only the first stage to the third stage were carried out, due to time and cost limitations of the researcher.

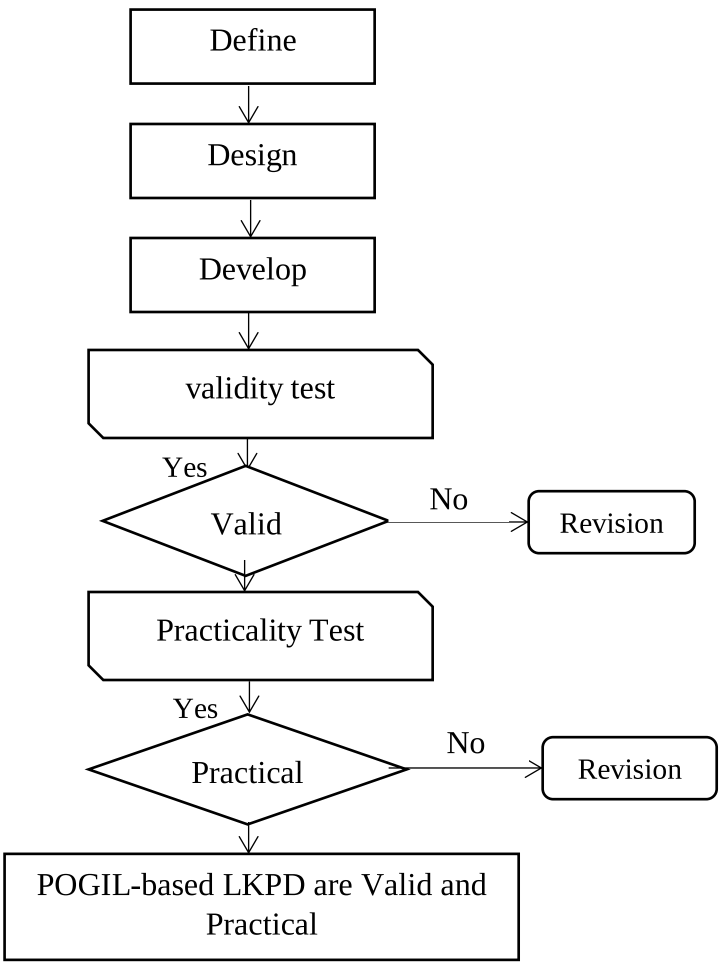


Figure 1. Research Procedure

The data analysis technique used to explain the research results is validity analysis and practicality analysis. Validity analysis is used to analyze the aspects contained in the questionnaire that will be assessed by each validator on the Student Worksheet (LKPD) developed by the researcher to determine its validity. The aspects in this validity questionnaire include content feasibility, presentation feasibility, language feasibility and graphic feasibility. Practicality analysis is used to analyze aspects of the practicality questionnaire to determine that the developed Student Worksheet (LKPD) is practical in its use by educators and students (Hulandari & Rahmi, 2022). To analyze the results of validity and practicality can be analyzed using the formula:

$$p = \frac{\Sigma score\ per\ item}{\Sigma max\ score} \times 100\%$$

The results obtained are presented using criteria based on the provisions in Table 2 (Mawarnis et al., 2023) :

Table 2. Assessment Criteria

Range Percentage	Criteria
0-20%	Not valid
21-40%	Less valid
41-60%	Moderately valid
61-80%	Valid
81-100%	Highly valid

RESULTS AND DISCUSSION

The research results are presented based on the 4-D development model, which includes the define, design and develop stages.

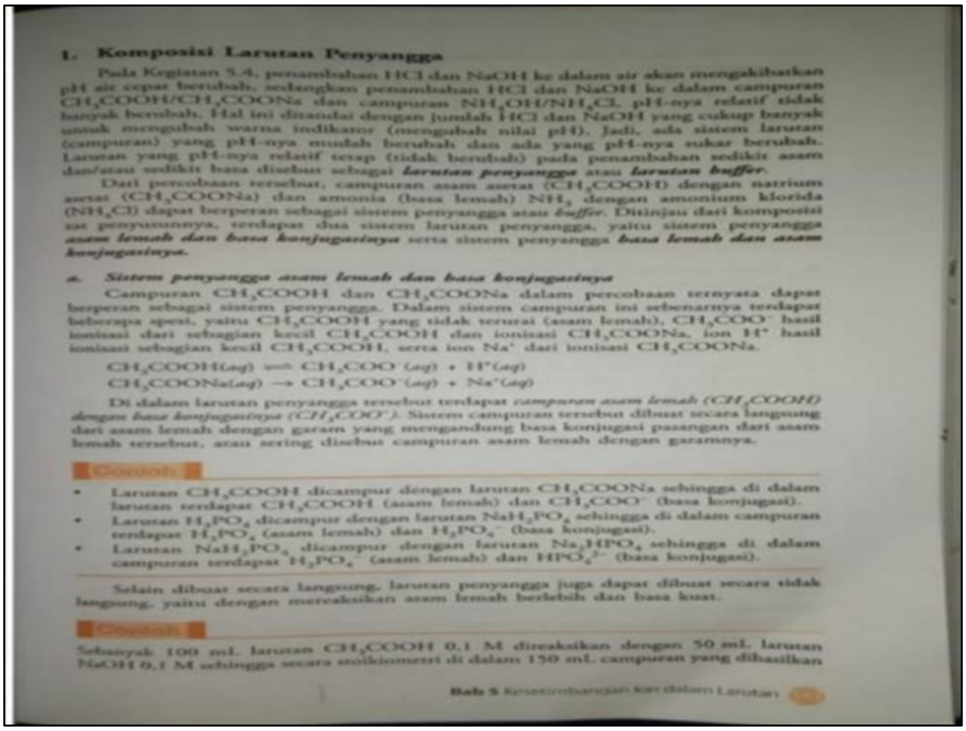
Define

The first stage carried out in this study, was the define stage. The define stage is carried out to understand the general picture of the implementation of chemistry learning in schools, identify and analyze the problems that occur by providing solutions to these problems. The define stage is carried out with several stages, namely needs analysis conducted by conducting interviews with chemistry educators, student analysis conducted by interviewing students and analyzing curriculum and materials.

The results of the needs analysis and student analysis show that chemistry learning in the classroom has been implemented quite well in terms of the use of models, media, and infrastructure that support learning used by educators. However, when delving deeper into the use of teaching materials, educators explain that there are problems faced regarding teaching materials. This is related to the textbooks used containing more material that is difficult for students to understand, explanations that are too long using rigid language, causing students to experience confusion in understanding the material presented in the textbooks. Textbooks also have an appearance that is less attractive to students, so students are less interested and motivated to learn. And the questions presented in the textbooks have not been able to stimulate students' critical thinking skills because the questions presented directly contain only numbers without any emphasis on one material concept that students will achieve. The impact of this causes students to often quickly feel bored in classroom learning activities, resulting in students not understanding the concept of the material being studied.

The package book used in learning chemistry, especially on buffer solution material can be seen in the following figure.

1. The teaching materials used in the form of package books contain more material with explanations using rigid language that is difficult for students to understand and has an unattractive appearance so that students are less interested and motivated to learn. The appearance of the material content in the package book can be seen in Figure 2.



1. Komposisi Larutan Penyangga

Pada Kegiatan 5.4, penambahan HCl dan NaOH ke dalam air akan mengakibatkan pH air cepat berubah, sedangkan penambahan HCl dan NaOH ke dalam campuran CH_3COOH/CH_3COONa dan campuran NH_4OH/NH_4Cl, pH-nya relatif tidak banyak berubah. Hal ini ditandai dengan jumlah HCl dan NaOH yang cukup banyak untuk mengubah warna indikator (mengubah nilai pH). Jadi, ada sistem larutan (campuran) yang pH-nya mudah berubah dan ada yang pH-nya sukar berubah. Larutan yang pH-nya relatif tetap (tidak berubah) pada penambahan sedikit asam dan/atau sedikit basa disebut sebagai ***larutan penyangga*** atau ***larutan buffer***.

Dari percobaan tersebut, campuran asam asetat (CH_3COOH) dengan natrium asetat (CH_3COONa) dan amonia (basa lemah) NH_3 dengan amonium klorida (NH_4Cl) dapat berperan sebagai sistem penyangga atau *buffer*. Ditinjau dari komposisi zat penyusunnya, terdapat dua sistem larutan penyangga, yaitu sistem penyangga ***asam lemah dan basa konjugasinya*** serta sistem penyangga ***basa lemah dan asam konjugasinya***.

a. Sistem penyangga asam lemah dan basa konjugasinya

Campuran CH_3COOH dan CH_3COONa dalam percobaan ternyata dapat berperan sebagai sistem penyangga. Dalam sistem campuran ini sebenarnya terdapat beberapa spesi, yaitu CH_3COOH yang tidak terurai (asam lemah), CH_3COO^- hasil ionisasi dari sebagian kecil CH_3COOH dan ionisasi CH_3COONa, ion H^+ hasil ionisasi sebagian kecil CH_3COOH, serta ion Na^+ dari ionisasi CH_3COONa.

$$CH_3COOH(aq) \rightleftharpoons CH_3COO^-(aq) + H^+(aq)$$
$$CH_3COONa(aq) \rightarrow CH_3COO^-(aq) + Na^+(aq)$$

Di dalam larutan penyangga tersebut terdapat *campuran asam lemah (CH_3COOH) dengan basa konjugasinya (CH_3COO^-)*. Sistem campuran tersebut dibuat secara langsung dari asam lemah dengan garam yang mengandung basa konjugasi pasangan dari asam lemah tersebut, atau sering disebut campuran asam lemah dengan garamnya.

Contoh

- Larutan CH_3COOH dicampur dengan larutan CH_3COONa sehingga di dalam larutan terdapat CH_3COOH (asam lemah) dan CH_3COO^- (basa konjugasi).
- Larutan H_3PO_4 dicampur dengan larutan NaH_2PO_4 sehingga di dalam campuran terdapat H_3PO_4 (asam lemah) dan $H_2PO_4^-$ (basa konjugasi).
- Larutan NaH_2PO_4 dicampur dengan larutan Na_2HPO_4 sehingga di dalam campuran terdapat $H_2PO_4^-$ (asam lemah) dan HPO_4^{2-} (basa konjugasi).

Selain dibuat secara langsung, larutan penyangga juga dapat dibuat secara tidak langsung, yaitu dengan mereaksikan asam lemah berlebih dan basa kuat.

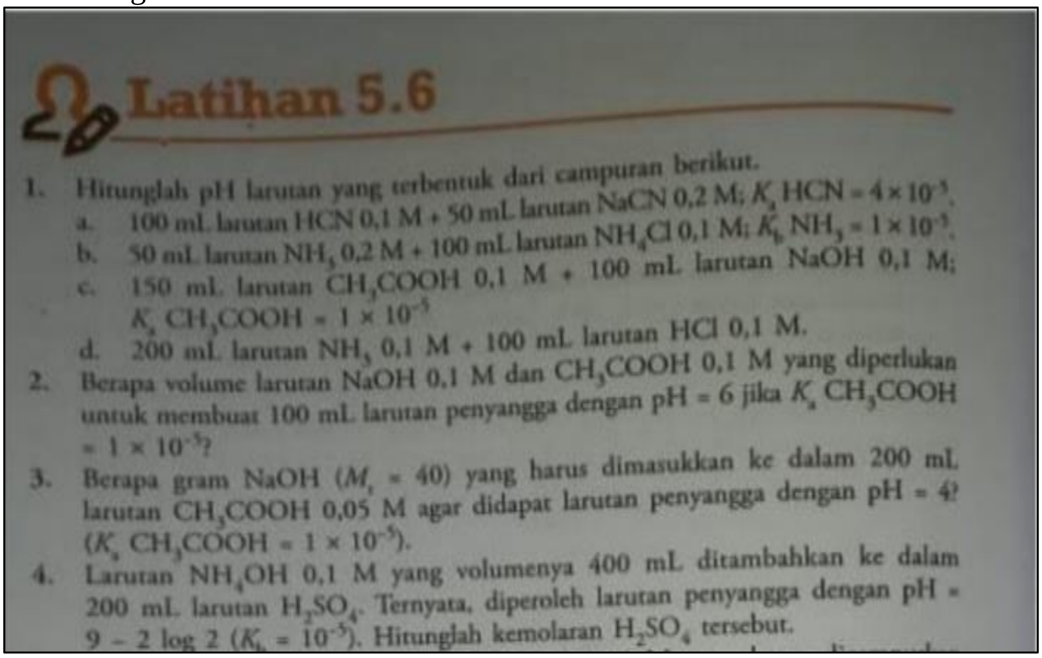
Contoh

Sebanyak 100 mL larutan CH_3COOH 0,1 M direaksikan dengan 50 mL larutan NaOH 0,1 M sehingga secara stoikiometri di dalam 150 mL campuran yang dihasilkan

Bab 5 Kesetimbangan Ion dalam Larutan

Figure 2. Material Display in the Package Book

2. The questions presented in the package book still cannot stimulate students' critical thinking skills. The questions only contain numbers without any emphasis on a concept that students will understand. The display of questions contained in the package book can be seen in Figure 3.



Latihan 5.6

1. Hitunglah pH larutan yang terbentuk dari campuran berikut.
   a. 100 mL larutan HCN 0,1 M + 50 mL larutan NaCN 0,2 M; K_a HCN = 4×10^{-5}.
   b. 50 mL larutan NH_3 0,2 M + 100 mL larutan NH_4Cl 0,1 M; K_b NH_3 = 1×10^{-5}.
   c. 150 mL larutan CH_3COOH 0,1 M + 100 mL larutan NaOH 0,1 M; K_a CH_3COOH = 1×10^{-5}
   d. 200 mL larutan NH_3 0,1 M + 100 mL larutan HCl 0,1 M.
2. Berapa volume larutan NaOH 0,1 M dan CH_3COOH 0,1 M yang diperlukan untuk membuat 100 mL larutan penyangga dengan pH = 6 jika K_a CH_3COOH = 1×10^{-5}?
3. Berapa gram NaOH (M_r = 40) yang harus dimasukkan ke dalam 200 mL larutan CH_3COOH 0,05 M agar didapat larutan penyangga dengan pH = 4? (K_a CH_3COOH = 1×10^{-5}).
4. Larutan NH_4OH 0,1 M yang volumenya 400 mL ditambahkan ke dalam 200 mL larutan H_2SO_4. Ternyata, diperoleh larutan penyangga dengan pH = 9 – 2 log 2 (K_b = 10^{-5}). Hitunglah kemolaran H_2SO_4 tersebut.

Figure 3. Display of Problems in the Package Book

The results of curriculum and material analysis show that the curriculum used by SMAN 2 Sawahlunto is the independent curriculum. Buffer solution material is found in the independent chemistry curriculum studied in Phase F (Permendikbud, 2022). Buffer solution is one of the materials that has characteristics involving chemical reaction mechanisms, and calculations involving various stages and contextual material. Buffer solution material is considered difficult because of its complex nature and many applications of mathematical calculations (Ilahi et al., 2023). Therefore, appropriate teaching materials and learning models are needed to support students' ability to solve these problems.

Design

In the design stage, the researcher refers to the results of the analysis stage to get an idea of designing products according to needs. The product to be designed by the researcher is a Student Worksheet (LKPD) based on Process Oriented Guided Inquiry Learning (POGIL) on buffer solution material. The design stage is carried out by a) compiling the Media Program Outline (GBPM), b) making a Flowchart in the form of graphic symbols that have their own meaning and significance showing the direction of activity flow in the Student Worksheet (LKPD), c) Collecting materials that will be needed to complete the designed LKPD. This stage is needed to design POGIL-based LKPD developed starting from the material, additional applications to create covers namely Canva, then combined in Microsoft Word. d) Combining the collected materials according to the design made in the POGIL-based LKPD.

The result of this design stage is to produce a draft of Student Worksheet Based on Process Oriented Guided Inquiry Learning (POGIL) on buffer solution material. POGIL-based LKPD consists of 5 learning stages. Here are excerpts of the stages in POGIL-Based LKPD:

Figure 4. Cover of LKPD

LKPD BERBASIS POGIL

Orientasi Peserta Didik Pada Masalah

Bacalah artikel dibawah ini dengan seksama!!!

Masyarakat nusantara masih berbagai tradisi yang telah mereka warisi dari nenek moyang. Salah satu peninggalan nenek moyang tersebut adalah nginang. Nginang biasanya dilakukan oleh para sesepuh dengan mengunyah ramuan yang terdiri dari campuran daun sirih, tembakau, injet, gambir dan buah pinang.

Gambar 9. Bahan-bahan Nginang
Sumber: https://images.app.goo.gl/VjhUeK5Ue7Bpvi5y9

Masyarakat memiliki kepercayaan bahwa nginang dapat memperkuat gigi, menghilaukan bau mulut, menyembuhkan sakit gigi serta dapat menyehatkan tubuh. Salah satu bahan yang digunakan untuk menginang adalah kapur atau kerap disebut kapur sirih. Air kapur memiliki rumus kimia $Ca(OH)_2$ merupakan basa kuat karena memiliki pH 11-12,5. Dikuti dari laman Kementrian Kesehatan Republik Indonesia disebutkan bahwa air kapur kerap digunakan dalam campuran makanan dan aman dalamjumlah sedikit. Hal tersebut karena didalam mulut terdapat air ludah yang dapat mempertahankan pH sekitar 6,8. Air liur mengandung larutan penyangga faosfat $H_2PO_4^{2-}$ dan HPO_4^{2-}. Pada system larutan penyangga ketika ditambahkan basa kuat, maka akan terjadi reaksi:

$Ca(OH)_{2\,(aq)} + NaH_2PO_{4\,(aq)} \rightarrow CaHPO_{4(aq)} + 2H_2O_{(l)}$

Pada kenyataannya, berdasarkan penelitian Kmisorei (2017), sebagian besar masyarakat Papua memiliki penumpukan plak pada gigi serta perubahan warna gigi yang rata-rata masyarakat menirih dalam jangka waktu yang lama hingga lebih dari lima tahun. Kandungan $Ca(OH)_2$ dengan pH yang tinggi akan menyebabkan rongga mulut bersifat basa dan menghasilkan suatu jenis oksigen reaktif yang dapat merusak sistem oksidasi DNA sel mukosa penyirih dan mempercepat penumpukan plak pada gigi.

Sumber : https://www.scribd.com/document/509387935/Nginang-Yang-Dipercaya-Memperkuat-Gigi-Revisi

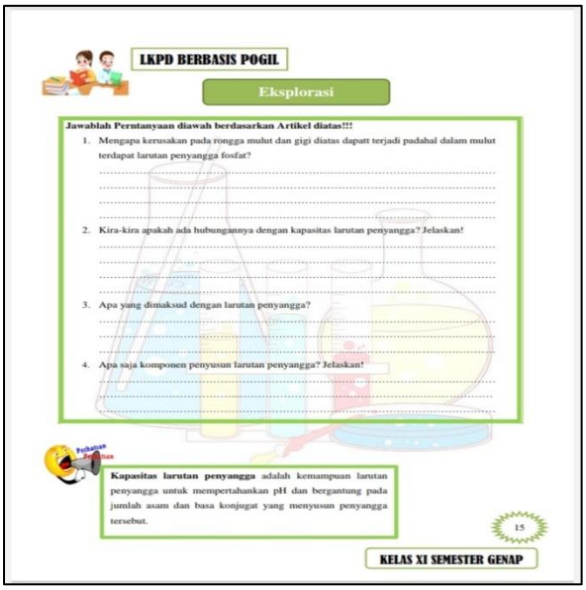
14

KELAS XI SEMESTER GENAP

Figure 5: Orientation stage

The Design stage aims to design the initial design of the POGIL-Based Student Worksheet (LKPD) and design research instruments. These instruments are in the form of validation sheets and practicality response questionnaires (Sainita et al., 2023). Description of the Process Oriented Guided Inquiry Learning (POGIL)-based Student Worksheet (LKPD) on buffer solution material that has been designed, where the contents of this POGIL-based

LKPD have learning activities that are tailored to the learning steps of the POGIL learning model itself. There are five syntaxes or learning steps in the POGIL learning model.



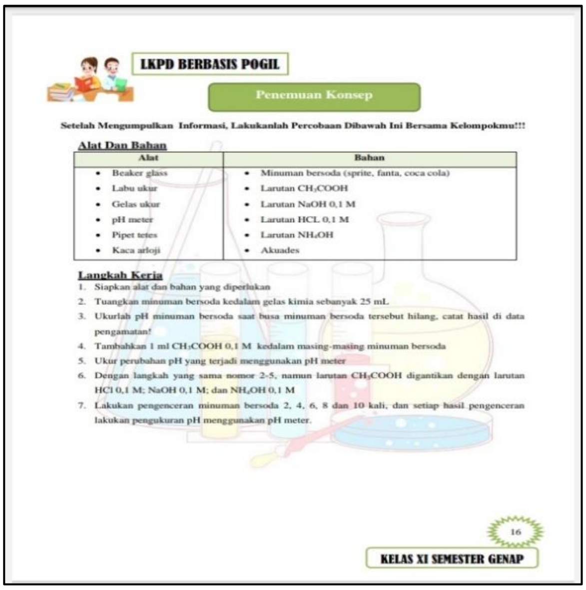
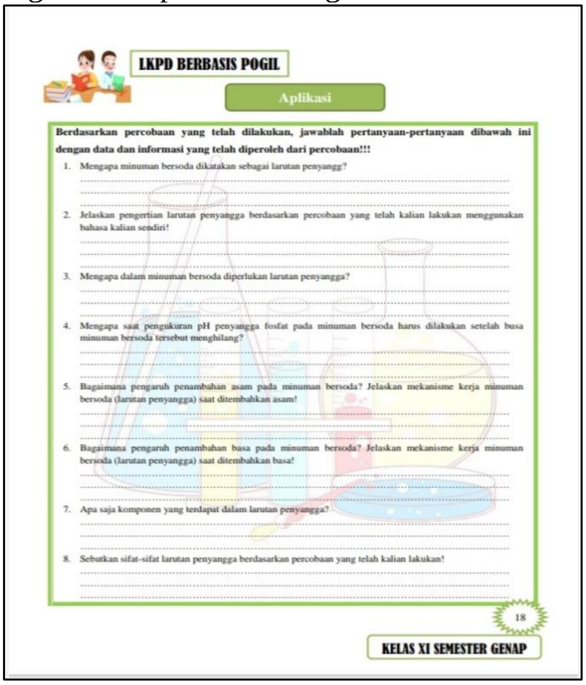


Figure 6. Exploration Stage

Figure 7. Concept discovery stage



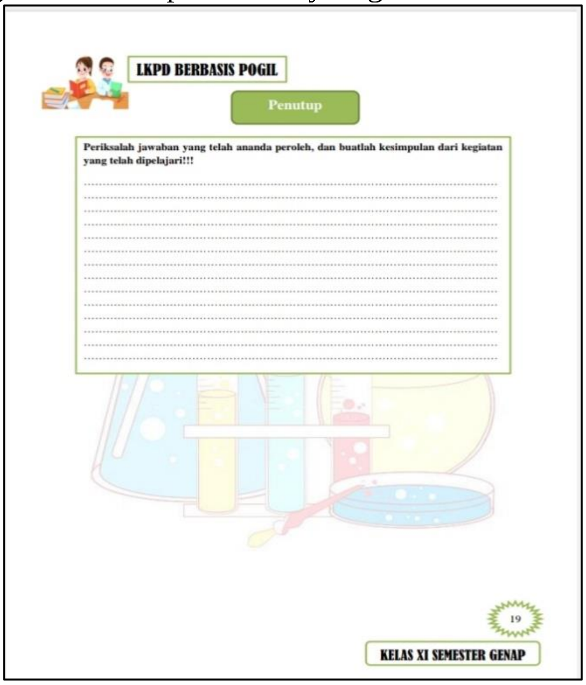


Figure 8. Application Stage

Figure 9. Closing Stage

The learning activities on the POGIL-based LKPD are about the orientation stage, the orientation stage is a learning activity related to providing image illustrations and explaining their relationship to the subject matter contained in the LKPD. The purpose of this stage is to prepare students to learn by increasing curiosity, creating interest and motivating students. Second, the exploration stage is the stage of providing questions related to the images that have been given at the orientation stage. The purpose of this stage is for students to gather information about the material through a series of questions. Third, the concept discovery stage, in this stage students are given an experiment and analyze questions through group activities guided by the educator so that students can understand the concepts of the subject matter. Fourth, the application stage, at this stage students are given exercises that aim to measure students' understanding of the mastery of material concepts that have been mastered by students. Finally, the closing stage, this stage contains students being able to draw conclusions from the learning activities that have been carried out and get feed back in the form of grades for students' understanding of the concepts of the material that has been learned (Adelia Alfama Zamista, 2015).

Develop

After completing the design stage, the POGIL-based Student Worksheet (LKPD) on buffer solution material was developed and underwent a validity test by validators consisting of 2 chemistry lecturers and 1 chemistry subject teacher. After the LKPD was validated and revised, it proceeded to the practicality assessment stage (Hulandari & Rahmi, 2022). The results of the validity and practicality tests obtained are as follows.

Table 3. Results of the POGIL-based LKPD Validity Test:

No	Aspects Validated	Validator			Total	Max		
		1	2	3		score	%	Description
1	Content feasibility	30	31	37	98	120	81,67	Highly valid
2	Presentation feasibility	39	33	43	115	132	87,12	Highly valid
3	Language feasibility	18	15	20	53	60	88,33	Highly valid
4	Graphics feasibility	36	30	37	103	120	85,83	Highly valid
Total		**123**	**109**	**137**	**369**	**432**	**85,42**	**Highly valid**

Based on the table above, the results of the validation test on the POGIL-based LKPD that has been carried out, when viewed from the aspect of content feasibility, showed very valid results with a percentage of 81.67%. This provides a statement indicating that the content feasibility aspect is in accordance with the learning objectives in the developed LKPD (Herman et al., 2022). When viewed from the aspect of presentation feasibility, it received an assessment with a percentage of 87.12% from the validators because the POGIL-based LKPD falls into the very valid category. This is because in the presentation feasibility aspect, there are several aspects assessed in general, namely the completeness of material presentation and the layout of activities in the LKPD that have been adjusted to the steps of the applied learning model, which is the POGIL learning model. In addition, the POGIL-based LKPD also presents attractive images that are relevant to the material, with a simple design and contrasting colors.

When viewed from the linguistic aspect, it achieved an assessment percentage of 88.33%, indicating that the POGIL-based LKPD can be categorized as very valid. This means that the language used in the POGIL-based LKPD is Indonesian with appropriate spelling and grammar (EYD), simple sentences, and easy to understand for high school level students. Thus, students can understand the concept of the material presented in the LKPD. This is supported by a statement from Herman et al., (2022) stating that teaching materials should use language that is adjusted to Indonesian language rules, where the use of good language in teaching materials is very necessary to facilitate readers in understanding them.

Meanwhile, the graphic aspect of the Student Worksheet reached an assessment percentage of 85.83%, indicating that the POGIL-based LKPD can be categorized as very valid. This is because the graphic feasibility aspect is said to be valid, as there are several aspects assessed by the validators, namely: 1) the physical size of the LKPD makes it easy for readers to carry, 2) The LKPD cover design has an attractive appearance that can foster students' interest in learning, 3) the design of the LKPD content is consistent in the placement of neat and systematic activity positions contained therein so that students are not confused in understanding the contents of the LKPD. BSNP (2007) requires that the graphic feasibility component includes: size/format, skin part design, and content part design.

To see the practicality of the product that the researcher developed, limited practicality was used, where the researcher only used a few students in conducting research using the POGIL-based LKPD. In this practicality test, there were 25 students and 2 chemistry educators. At this stage, students and educators will be given a response questionnaire on the practicality of the POGIL-based LKPD. In theory, a practicality test is said to be practical when the teaching materials developed can be applied and used by students in understanding learning, and can facilitate students in understanding the material taught by educators in learning activities (Saputri et al., 2020). This is in line with the results of the Practicality test of the POGIL-based LKPD obtained a percentage of 92.31% from the assessment of educators and 82.15% from the assessment of students. Learning challenges faced by applying POGIL-based LKPD on buffer solution material in class where students are not accustomed to learning by doing individual concept discovery activities through group learning activities because in general the learning applied in class is usually conventional learning with the lecture method. The results of the practicality test of the POGIL-based LKPD can be seen in Table 4 and Table 5.

Table 4. Results of Educator Practicality Test of POGIL-based LKPD

No	Aspects	Total	Max Score	%	Description
1	Ease of Use	31	32	96,88	Very practical
2	Learning time efficiency	20	24	83,33	Very practical
3	The attractiveness of LKPD	30	32	93,75	Very practical
4	Benefits of LKPD	15	16	93,75	Very practical
Sum and average		**96**	**104**	**92,31**	**Very practical**

Table 5. Students' Practicality Test Results on POGIL-based LKPDs

No	Aspects	Sum	Max Score	%	Description
1	Ease of Use	329	400	82,25	Very practical
2	Learning time efficiency	228	300	76	Practical
3	The attractiveness of LKPD	343	400	85,75	Very practical
4	Benefits of LKPD	168	200	84	Very practical
Sum and average		**1.068**	**1.300**	**82,15**	Very practical

CONCLUSION

Student Worksheet (LKPD) based on POGIL on buffer solution material for class XI at SMAN 2 Sawahlunto. From the research results and data analysis that has been carried out, the following conclusions can be drawn: the results of the validity test of the POGIL-based LKPD have met the very valid criteria with a percentage of 85.42% assessed based on aspects of content feasibility, presentation feasibility, language feasibility, and graphic feasibility. The results of the educator practicality response questionnaire to the POGIL-based LKPD have met the very practical category with a percentage of 92.31% and the results of the student practicality response questionnaire to the POGIL-based LKPD on Buffer Solution material have met the very practical category with a percentage of 82.15%.

RECOMMENDATION

Based on the research that has been done, there are several suggestions for further research are the research is continued to the effectiveness test stage. Next, development of Student Worksheets (LKPD) based on process oriented guided inquiry learning (POGIL) on other chemical materials. Last, this research was conducted with a limited number of students in one class, further research should be carried out with a larger number of students.

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