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Project Based Practicum Student Worksheet on Buffer Solution Material

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Abstract

Practicum-based worksheets have been proven to improve students' thinking abilities. This research aims to describe the design and determine the feasibility of a project-based practical worksheet on buffer solution material. This research uses the Borg & Gall development model which consist of analyzing potential problems stage, data collection, product design, product marketing, product analysis and revision. The research subjects were 11th grade students from two different senior high school. The validation results show that the project learning-based student worksheet is classified as very valid with a score of 93 for small scale, 96 for medium scale, and 99 for large scale. The media was declared suitable for use based on the results of trials on small, medium and large-scale students in the very good category with scores of 50, 51, and 55 respectively. This shows that project-based practical worksheets on buffer solution material are suitable for application to students.

Keywords: buffer solution, project-based learning, student worksheet

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1. Introduction

Current chemistry learning requires students to be able to master several important types of abilities including critical thinking skills, creative thinking skills, problem-solving skills, and the ability to communicate and collaborate, as a result of the student learning process in addition to their success in fulfilling learning indicators (Nuha et al., 2020). Teachers need to understand that students' mastery of these abilities cannot occur without a good learning plan, including the selection of learning methods and learning media. One of the learning media that is often used by teachers in constructing chemistry knowledge is the Student Worksheet (LKPD).

Based on the results of interviews and observations conducted by researchers, it is known that the LKPD which is commonly used in learning activities is considered less scientific and innovative so it makes difficult for students to understand the material and causes boredom in studying chemistry. The material content contained in the LKPD is no different from the sourcebook as teaching material, so students are not motivated to use the LKPD as a learning medium. In addition, the LKPD developed by the teacher is also not attractive and has not been integrated with the project-based learning model.

LKPD is a teaching medium that contains steps for the construction of materials that students need to work on (Yildirim et al., 2011). LKPD is designed systematically and aligned with learning objectives to guide students to master concepts and actively participate in collaborative discussion activities (Çelikler, 2010; Evans & Cleghorn, 2022). The development of LKPD needs to pay attention to the characteristics that must be met, which are guiding, directing, and empowering students to study independently, improve critical thinking skills, and the ability to learn collaboratively (Aprianty et al., 2020). One way to fulfill this character is to integrate models and innovative learning methods explicitly in LKPD.

Project Based Learning (PjBL) is a learning model that can be used as an effort to develop scientific abilities, conceptual understanding, psychomotor, creativity, and student motivation (Aprianty et al., 2020; Kuo et al., 2019). The application of PjBL in science learning, one of which is chemistry, can encourage the fulfillment of 21st-century abilities that are important for students to possess (Desiana et al., 2022). The problem that often arises in learning science is that there is a distance between the knowledge that students acquire in learning and the problems that they find in their surroundings related to natural phenomena. This condition is caused by the teacher only making students learning participants who are not trained to actively construct their knowledge. Regarding these problems, PjBL exists as a learning model that allows students to actively participate in solving real problems through authentic projects (Guo et al., 2020).

PjBL has several advantages including (containing guiding questions, focusing on learning objectives, increasing active participation in learning, collaboration, increasing student experience of using technology, and being able to produce real, authentic products) (Guo et al., 2020; Miller & Krajcik, 2019). There are 5 steps in implementing PjBL in learning : (1) Orientation in problems, where the problems to be solved by students are real problems found in surrounding life-related to the concepts being studied; (2) Organizing students, teachers help students organize learning tasks related to problems; (3) Group and individual investigations, students collaborate to collect information and carry out experiments that can help solve problems; (4) Developing works, students prepare and design appropriate works based on their findings; (5) Analyzing the project being developed, in large classes students and the teacher analyze the correctness of the concept in the project that has been developed (Kokotsaki et al., 2016; Tsybulsky & Muchnik-Rozanov, 2019). The difference between the Problem-Based Learning (PBL) and PjBL models is that PBL focuses on problem analysis while PjBL has two focuses, which are problem analysis and efforts to solve it.

The integration of the PjBL model into LKPD to teach chemistry concepts is the right effort. One of the chemical concepts that can be taught through the PjBL model is the concept of a buffer solution. Based on the results of the interviews it was found that the buffer solution material was one of the materials that the students found difficult. In addition, there are often misconceptions related to the character of the buffer solution. Buffer solution is a microscopic chemical concept. Concepts in buffer solutions also have many applications in everyday life and can be easily applied as a basis for making projects in PjBL (Wardani & Firdaus, 2019).

The novelty of this study is that the LKPD that was developed is very contextual and by the characteristics of students in Sikka.

One of the efforts to teach the concept of buffer solution to students is to involve students in practicum activities which are also bridged through the PjBL model. Based on this, researchers feel it is important to conduct research related to "Development of Project Based Learning Model-Based Buffer Solution Practicum Worksheets for 11th grade High School Students.

2. Research Method

The type of research used in this research, is research and development (R&D) with the Borg & Gall model (Sugiyono, 2019) consists of 9 stages which include: the potential problem, data collection stage, product design stage, small-scale trial, small scale product analysis & revision, medium scale trial, medium scale product analysis & revision, large-scale trial phase, final product analysis & revision stage. The population in this study were students from SMAS St. Peter

Kewapante and SMAN 1 Talibura. Meanwhile, the sample in this study was 50 students in 11th grade of SMAS St.Petrus Kewapante and SMAN 1 Talibura.

The data collection techniques used were interviews and questionnaires. The instruments used in this research consisted of interview sheets and LKPD eligibility questionnaire sheets.

The data analysis technique used in this research is validity analysis and feasibility questionnaire for LKPD. Media validity criteria according to Riduwan (2012) are presented in Table 1.

Table 1. LKPD Validity Criteria

No	Number (%)	Validity Criteria
1	80<X≤100	Very valid
2	60<X≤80	Valid
3	40<X≤60	Quite valid
4	20 <X ≤40	Less valid
5	X >20	Very Invalid

After validation, a product trial is carried out on teachers and students to determine the suitability of the LKPD. Product feasibility categories are determined using the formula (Widoyoko, 2012) presented in Table 2.

Table 2. Product Eligibility Category

No	Score Range	Category
1	$X>\bar{X}i + 1{,}8 \times sb_i$	Very good
2	$\bar{X}i + 0{,}6 \times sb_i < X \leq \bar{X}i + 1{,}8 \times sb_i$	Good
3	$\bar{X}i - 0{,}6 \times sb_i < X \leq \bar{X}i + 0{,}6 \times sb_i$	Enough
4	$\bar{X}i - 1{,}8 \times sb_i < X \leq \bar{X}i + 0{,}6 \times sb_i$	Less
5	$X \leq \bar{X}i - 1{,}8 \times sb_i$	Very Less

Based on Table 2, the teacher's assessment of product suitability can be seen in Table 3.

Table 3. Result of Worksheet Feasibility Assessment by Teacher

No	Range Score	Category
1	X>85	Very good
2	70<X≤85	Good
3	55<X≤70	Enough
4	40<X≤70	Less
5	X≤40	Very less

The analyzed student response questionnaire is processed into feasibility assessment categories in Table 4.

Table 4. Result of Worksheet Feasibility Assessment by Student

No	Renting Score	Category
1	X>47,6	Very good
2	39,2<X≤47,6	Good
3	30,8<X≤39,2	Enough
4	22,4<X≤39,2	Less
5	X≤22,4	Very less

3. Result and Discussion

Research and development refer to the Borg & Gall model which includes nine stages. The development research stages include potential problem stage, data collection stage, product design stage, small-scale trial stage, small-scale product analysis & and revision stage, medium-scale trial stage, analysis stage & and mid-scale product revision, large-scale trial phase and product analysis & and revision stage. An explanation of the development stages will be explained as follows.

3.1. Potential Problems

At the potential problem stage, researchers conducted interviews with teachers and students at SMAS St. Peter Kewapante and SMAN 1 Talibura. Interview activities were carried out with teachers who taught chemistry subjects. The interview aims to analyze the needs of teachers and students and to obtain information regarding the chemistry learning situation in the classroom. The results of interviews with teachers and students are shown in Table 5.

Table 5. Interview Result

No	Indicator	Teacher	Student
1	Study preparation	Prepare learning tools such as syllabus, RPP, and LKPD	Prepare yourself by reading a book
2	Learning resources	Textbooks, chemistry modules, and the Internet	Textbooks and LKPD
3	Student understanding	Material related to concepts and calculation formulas such as acids and bases, buffer solutions, solubility, and solubility products.	Acids and bases, buffer solutions, reaction rates, and chemical bonds
4	Learning methods and media	Discussion and more discovery learning	Lectures and discussions
5	Chemistry Practical LKPD	can help students learn to work together and can increase creativity in carrying out experiments.	Practical LKPD contains learning objectives, study instructions, supporting information, work steps, and assessment.
6	Criteria for developing LKPD	It is prepared in language that is easy to understand and it is hoped that this media can help students to develop their skills in carrying out practicums.	More interesting and the words used are easy to understand.

3.2. Data Collection

At this stage, all data was obtained from several references, which are chemistry student books for SMA/MA 11th grade, SMA chemistry E-Modules, and Basic Chemistry books. From the literature study, the syllabus, lesson plans, and sub-material regarding buffer solutions were taken.

3.3. Product Design

The product developed by researchers has an LKPD component design which aims to make it easier for students in the learning process and understand the material. The PjBL-based practicum LKPD product design is presented in Figure 1.

Figure 1. Design Product LKPD

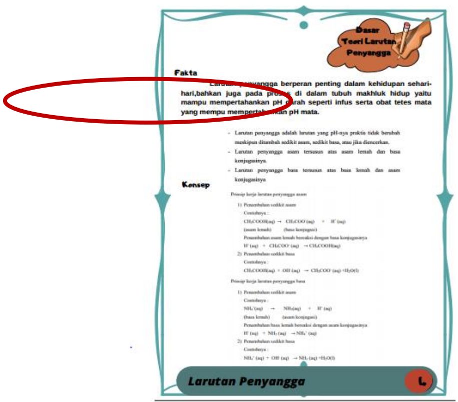
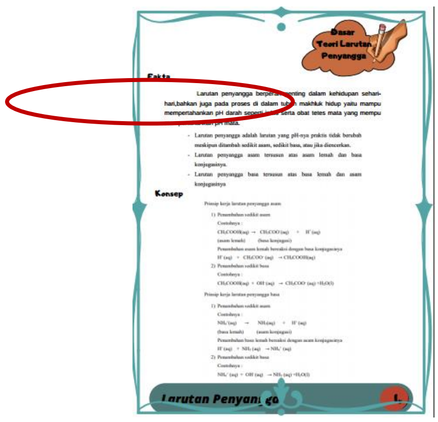
The practicum LKPD is based on project-based learning on buffer solution material for class The results of the LKPD validation are presented in Table 6.

Table 6. Validation Results

No	Validation	Presentation (%)	Criteria
1	Material	93.33	Very Valid
	Material suitability	94.44	Very Valid
	Presentation of material	91.67	Very Valid
2	Media	91.67	Very Valid
	Graphics	100	Very Valid
	Communicative	93.75	Very Valid
	Straightforwardness	83.33	Very Valid
	Suitability to student development	90.00	Very Valid
3	Language	88.33	Very Valid
	Conformity to language rules	83.33	Very Valid
	Communicative	100	Very Valid
	Straightforwardness	75.00	Very Valid
	Suitability to student development	93.75	Very Valid
4	Practitioner	92.50	Very Valid
	Material	93.75	Very Valid
	Media	91.08	Very Valid
	Language	93.75	Very Valid
5	PjBL syntax	91.37	Very Valid
	Determination of fundamental	85.25	Very Valid
	Questions preparing project	90.75	Very Valid
	Planning and arranging a schedule	92.15	Very Valid
	Monitoring learners and project progress	91.75	Very Valid
	Results assessment	95.00	Very Valid
	Evaluating experience	93.35	Very Valid
6	Rerate validity	91.44	Very Valid

After being validated by the validator, the practicum LKPD is then revised based on suggestions and input from validators and practitioners. Suggestions and revisions from validators can be seen in Table 7.

Table 7. Suggestions and Revision of Product Validation Results

Before Revision	After Revision
Suggestion: Use the same font and typeface	
	
Suggestion: Product name should not be displayed	

Based on research conducted by Refitaniza & Effendi (2022) which explains that the integrated STEAM-PjBL (Science, Technology, Engineering, Art, and Mathematic-Project Based Learning) LKPD on Buffer Solution material is valid and practical to use by having validity and practicality criteria tall one. This opinion is in line with research conducted by Alti (2021) that guided inquiry-based worksheets are valid and suitable for use with categories of very high validity and high practicality.

3.4. Small Scale Trial

Practical LKPD products based on project-based learning on buffer solution material for 11th grade SMA which have been validated and revised and then tested on a small scale. Small-scale trials were carried out by giving feasibility test questionnaires to 10 classes.

3.5. Small Scale Product Analysis & Revision

After testing the LKPD product, researchers improved or revised it based on input and suggestions from students and teachers. The results of the analysis on small-scale trials (ten student and one chemistry teacher), chemistry teacher get score 93, three student get score 49, two students get score 50, one student get score 51, three students get score 52, and one student get score 53.

3.6. Medium Scale Trial

Practical LKPD products that have been revised after carrying out small-scale trials are then tested on medium-scale product trials. The product trial phase involved 20 students 11th grade (10 students from SMAS St. Petrus Kewapante and 10 students from SMAN 1 Talibura) and two teachers.

3.7. Analysis Stage and Mid-scale Product Revision

Suggestions and input on medium-scale trials as input for revising the LKPD. Researchers improve or revise based on input and suggestions from students and teachers. The result are two chemistry teachers get score 94 and 98, two students get score 49, three students get score 50, five students get score 51, five students get score 52, four students get score 53, and one student get score 54.

3.8. Large Scale Trial Phase

The practicum LKPD product is based on project-based learning on buffer solution material for 11th grade SMA which has been revised and then tested in a large-scale trial. The large-scale trial involved 50 students 11th grade (15 students from SMAS St. Petrus Kewapante and 35 students from SMAN 1 Talibura) and two chemistry teachers.

3.9. Product Analysis and Revision Stage

Based on the results of large-scale product trials, there was no input or suggestions from student teachers to improve or revise the project-based learning-based practicum LKPD product. The results of the analysis on large-scale trials are two chemistry teachers get score 99, two students get score 47 ,one student get score 48, three students get score 49, eight students get score 50, nine students get score 51, eleven students get score 52, seven students get score 53, six students get score 54, and two students get score 55.

3.9.1 Data Analysis

3.9.1.1 Teacher Feasibility Analysis

Analysis of data from teacher questionnaires is divided into three parts, which are small, medium, and large-scale analysis. The results of the practicum LKPD feasibility assessment was respectively 93, 96, and 99. Thus it can be said that based on the criteria for assessing product suitability by teachers in Table 3, the practicum LKPD products in small, medium, and large-scale trials are classified as very good for use. in chemistry learning. The increase in scores from each trial was due to revisions and improvements based on input and suggestions from the chemistry teacher. The results of the teacher eligibility questionnaire analysis can be seen in Figure 2.

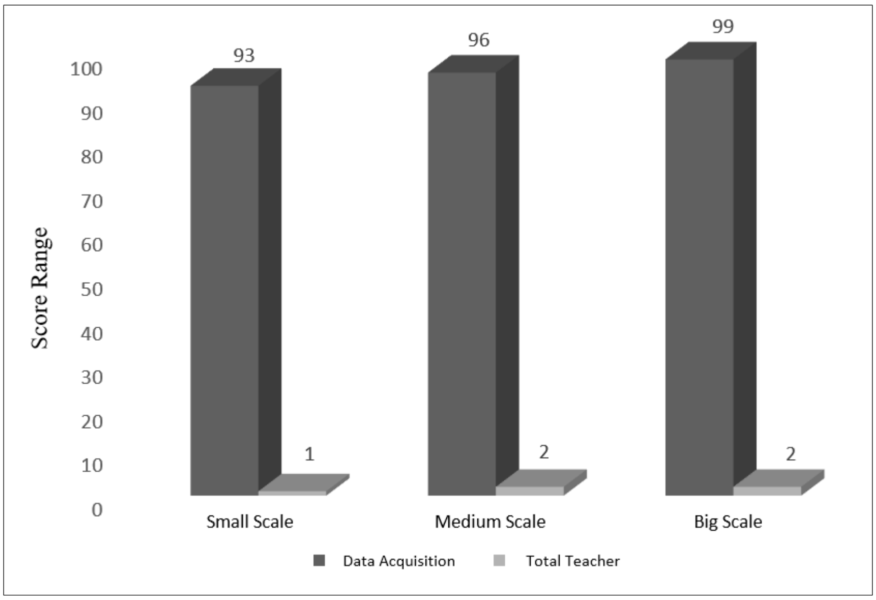


Figure 2. Results of Teacher Eligibility Analysis

3.9.1.2 Student Feasibility Analysis

Analysis of data from student questionnaires is divided into three parts: small, medium, and large-scale analysis. The results of the practicum LKPD feasibility assessment respectively 50.51 and 55. Thus it can be said that based on the criteria for assessing product suitability by students in Table 4, the practicum LKPD products in small, medium, and large-scale trials are classified as very good for use. in chemistry learning. The increase in scores from each trial was due to revisions and improvements based on input and suggestions from students as well as the increase in the number of students. The results of the student eligibility questionnaire analysis can be seen in Figure 3.

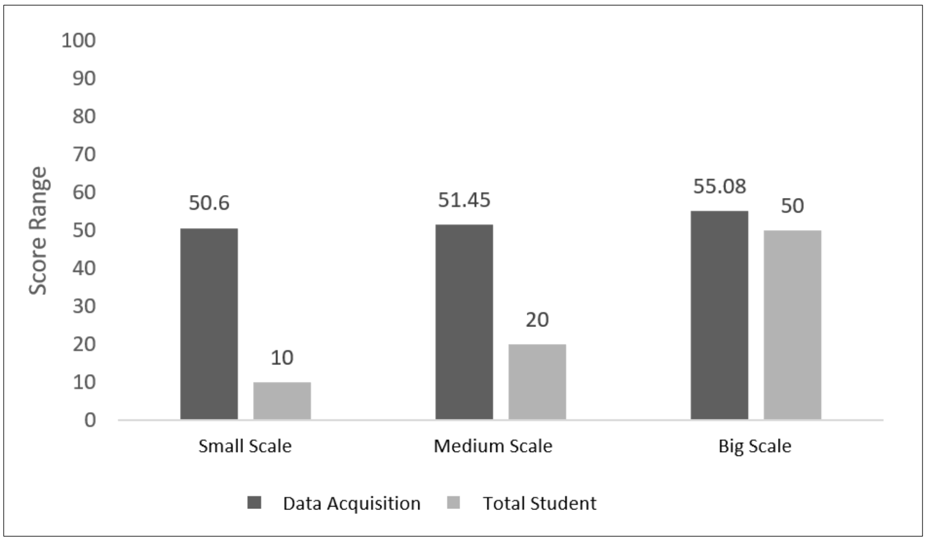


Figure 3. Results of Student Eligibility Analysis

This condition is in line with research conducted by Fatisa & Br Gilingging (2021) entitled Design and Trial of Electronic Smart Worksheets Based on POE (Predict, Observe,

Explain) on Acid-Base Topic which states that based on the results of validation tests by material experts, media experts, practical tests by teachers and student responses, it was found that student worksheets can be used in the learning process. Apart from that, Noprinda & Soleh (2019) explained that the Student Worksheet (LKPD) for physics learning based on Higher Order Thinking Skill (HOTS) on the resulting Static Electricity material has been developed to be valid and suitable for use by students in learning.

Susilawati et al. (2020) revealed that implementing worksheets can increase students' learning activities. Student worksheets can increase students' competence understanding and knowledge (Yustina & Kapsin, 2017). Another opinion expressed by Gani et al. (2017) shows that student worksheets can improve spatial visual intelligence and student learning outcomes.

Pratama & and Saregar (2019) explained that student worksheets based on scaffolding are very suitable to be used as an alternative learning media. This opinion is supported by Irsalina & and Dwiningsih (2018) who revealed that the student worksheets developed are suitable for use in learning activities both online and offline.

The development of integrated student worksheets with a scientific approach is suitable for use in the learning process and can support the learning process to achieve learning objectives (Mutmainah et al., 2018). Another condition was revealed by Oktasari et al. (2019) which states that student worksheets can greatly improve their verbal and written communication skills.

This research is in line with research conducted by Nurhikmayati & and Sunendar (2020) who developed Project Learning Based on Local Wisdom Oriented to Creative Thinking Ability and Learning Independence, where the results of the research show that the learning model developed meets the criteria of being valid, practical and effective for ability. creative thinking and independent learning. Apart from that, the same research was also conducted by Rauziani et al. (2016) who applied the Project Based Learning (PjBL) model to improve students' learning outcomes and critical thinking where the research results show that the PjBL model can provide good responses to students and help students think critically.

Nurazlina et al., (2022) developed LKPD by combining character values in buffer solution material where the research results showed that the LKPD developed was suitable in terms of material, media, and pedagogical aspects for use in learning and received a positive response from teachers and students. LKPD that combines STEAM – PjBL in Buffer Solution material is valid with an Aiken's index value of 0.87 and high practicality by teachers and students (Refitaniza & Effendi, 2022).

4. Conclusion

Based on the results of the practical LKPD product development research, it can be concluded that this research procedure refers to the Borg & Gall development model which was modified into nine stages including potential problems, data collection, product design, small scale trials, small scale product revisions, product trials middle class, medium scale product revisions, medium scale product revisions, large scale product trials, product revisions and improvements. Practical LKPD learning media on buffer solution material for 11th grade is suitable for use by teachers and students in chemistry learning.

Suggestions from this research for teachers, the results of this research can add references for developing practical LKPD on chemistry material other than buffer solutions in chemistry learning. Students are expected to be able to utilize practical LKPD to develop thinking skills, have curiosity and be able to understand buffer solution material. It is hoped that schools can facilitate the development of learning media with game characteristics so that students can be actively involved in learning.

References

Alti, R. M. (2021). Development of Guided Inquiry-Based Worksheet as Teaching Materials on Elements, Compounds, and Periodic Table. *JTK (Jurnal Tadris Kimiya)*, *6*(1), 124–131. https://doi.org/10.15575/jtk.v6i1.10377

Aprianty, H., Gani, A., & Pada, A. U. T. (2020). Implementation of project-based learning through stem approach to improve students' science process skills and learning outcomes. *Jurnal Tadris Kimiya*, *5*(2), 144–152. https://doi.org/https://doi.org/10.15575/jtk.v5i2.8370

Çelikler, D. (2010). The Effect of Worksheets Developed for the Subject of Chemical Compounds on Student Achievement and Permanent Learning. *Educational Research Association The International Journal of Research in Teacher Education*, *1*(1), 42–51. Retrieved from https://ijrte.penpublishing.net/files/5/manuscript/manuscript_101/ijrte-101-manuscript-103943.pdf

Desiana, G. ., Sulastri, & Syahrial. (2022). Application of Project-Based Learning (PjBL) to Improve Critical Thinking Skills and Students' Learning Independence on the Making of Colloids in Dispersion. *JTK: Jurnal Tadris Kimiya*, *7*(1), 37–52. https://doi.org/https://doi.org/10.15575/jtk.v7i1.13395 1.

Evans, R., & Cleghorn, A. (2022). Do student teachers see what learners see? – Avoiding instructional dissonance when designing worksheets. *South African Journal of Childhood Education*, *12*(1), 1–10. https://doi.org/10.4102/sajce.v12i1.1015

Fatisa, Y., & Br Galingging, E. A. (2021). Design and Trial of Electronic Smart Worksheets Based on POE (Predict, Observe, Explain) on Acid-Base Topic. *JTK (Jurnal Tadris Kimiya)*, *6*(1), 51–61. https://doi.org/10.15575/jtk.v6i1.9853

Gani, A., Safitri, R., & Mahyana, M. (2017). Improving the visual-spatial intelligence and results of learning of junior high school students with multiple intelligences-based students worksheet learning on lens materials. *Jurnal Pendidikan IPA Indonesia*, *6*(1), 16–22. https://doi.org/10.15294/jpii.v6i1.9594

Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, *102*, 1–13. https://doi.org/10.1016/j.ijer.2020.101586

Irsalina, A., & Dwiningsih, K. (2018). Practicality Analysis of Developing the Student Worksheet Oriented Blended Learning in Acid-Base Material. *JKPK (Jurnal Kimia Dan Pendidikan Kimia)*, *3*(3), 171–182. https://doi.org/10.20961/jkpk.v3i3.25648

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). *Improving Schools Project-based learning : A review of the literature*. 1–11. https://doi.org/10.1177/1365480216659733

Kuo, H. C., Tseng, Y. C., & Yang, Y. T. C. (2019). Promoting college students' learning motivation and creativity through a STEM interdisciplinary PBL human-computer interaction system design and development course. *Thinking Skills and Creativity*, *31*, 1–10. https://doi.org/10.1016/j.tsc.2018.09.001

Miller, E. C., & Krajcik, J. S. (2019). Promoting deep learning through project-based learning : a design problem. *Disciplinary and Interdisciplinary Science Education Research*, *1*(7), 1–10. Retrieved from https://diser.springeropen.com/articles/10.1186/s43031-019-0009-6

Mutmainah, S., Usman, U., & Nurhadi, M. (2018). Development of Applicative-Integrative Student Worksheet Based on Scientific Approach on Reaction Rate Subject. *JKPK (Jurnal Kimia Dan Pendidikan Kimia)*, *3*(1), 6–12. https://doi.org/10.20961/jkpk.v3i1.11982

Noprinda, C. T., & Soleh, S. M. (2019). Pengembangan lembar kerja peserta didik (LKPD) berbasis higher order thinking skill (HOTS). Indonesian Journal of Science and Mathematics Education, 2(2), 168-176. http://dx.doi.org/10.24042/ijsme.v2i2.4342

Nuha, D. N., Febriana, B. W., & Merdekawati, K. (2020). Implementation of Project Based Learning (PjBL) Learning Model Through Wall Magazine Towards Learning Achievement and Collaborative Skills. *International Journal of Chemistry Education Research*, *4*(1), 37–41. https://doi.org/10.20885/ijcer.vol4.iss1.art6

Nurazlina, Asyhar, R., & Ernawati, M. D. W. (2022). Pengembangan LKPD Larutan Penyangga Berbasis Proyek yang Terintegrasi Nilai Karakter Development of Project-Based Buffer Solution Worksheets the Integrated Character Values. *Jurnal Penelitian Pendidikan, Psikologi Dan Kesehatan*, *3*(3), 251–256. Retrieved from https://www.jurnalp3k.com/index.php/J-P3K/article/view/192

Nurhikmayati, I., & Sunendar, A. (2020). Pengembangan Project Based Learning Berbasis Kearifan Lokal Berorientasi pada Kemampuan Berpikir Kreatif dan Kemandirian Belajar Mosharafa : Jurnal Pendidikan Matematika Mosharafa : Jurnal Pendidikan Matematika. *Jurnal Pendidikan Matematika*, *9*(1), 1–12. Retrieved from https://onesearch.id/Record/IOS15444.article-604?widget=1&library_id=2760

Oktasari, D., Jumadi, Warsono, Hariadi, M. H., & Syari, E. L. (2019). 3D Page-Flipped Worksheet on Impulse-Momentum To Develop Students' Scientific Communication Skills. *Jurnal Pendidikan IPA Indonesia*, *8*(2), 211–219. https://doi.org/10.15294/jpii.v8i2.15737

Pratama, R. A., & Saregar, A. (2019). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Scaffolding Untuk Melatih Pemahaman Konsep. *Indonesian Journal of Science and Mathematics Education*, *2*(1), 84–97. https://doi.org/10.24042/ijsme.v2i1.3975

Rauziani, Yusrizal, & Nurmaliah, C. (2016). Implementasi Model Project Based Learning (PjBL) dalam meningkatkan hasil belajar dan berpikir kritis. *Pendidikan, Jurnal Indonesia, Sains*, *04*(02), 39–44. Retrieved from https://jurnal.unsyiah.ac.id/JPSI/article/view/7577/0

Refitaniza, & Effendi. (2022). Pengembangan LKPD Terintegrasi STEAM-PjBL Pada Materi Larutan Penyangga Sma. *Jurnal Ilmiah Universitas Batanghari Jambi*, *22*(3), 1662–1667. https://doi.org/10.33087/jiubj.v22i3.2682

Riduwan. (2012). *Skala pengukuran variabel-variabel penelitian*. Yogyakarta: Alfabeta.

Sugiyono. (2019). *Metode penelitan kuantitatif ,kualitatif, R&D*. CV. Yogyakarta: Alfabeta.

Susilawati, Copriady, J., Erna, M., Hasnah, Rendra, Nisa, N. A., & Rahmatya, O. (2020). *Application of Constructivism – Based Students ' Worksheet To Increase students activities and learning outcomes*. *1*(5), 1–13. https://doi.org/10.15575/jtk.v5i1.5607

Tsybulsky, D., & Muchnik-Rozanov, Y. (2019). The development of student-teachers' professional identity while team-teaching science classes using a project-based learning approach: A multi-level analysis. *Teaching and Teacher Education*, *79*, 48–59. https://doi.org/10.1016/j.tate.2018.12.006

Wardani, S., & Firdaus, L. (2019). Pengaruh model inkuiri terbimbing berbasis blended learning terhadap kemampuan kognitif-psikomotor pada materi larutan penyangga. *Jurnal Tadris Kimiya*, *4*(2), 189–201. Retrieved from https://journal.uinsgd.ac.id/index.php/tadris-kimiya/article/view/5404/pdf

Widoyoko, S. E. P. (2012). *Teknik Penyusunan Instrumen Penelitian*. Yogyakarta: Pustaka Pelajar.

Yildirim, N., Kurt, S., & Ayas, A. (2011). The effect of the worksheets on students' achievement in chemical equilibrium. *Journal of Turkish Science Education*, *8*(3), 44–58. Retrieved from https://www.researchgate.net/publication/268436313_The_Effect_Of_The_Worksheets_On_Students'_Achievement_In_Chemical_Equilibrium

Yustina, & Kapsin. (2017). *THE Implementation Of Constructivism-Based Student Worksheets Within The Theme 'The Prevention Of Land And Forest Fire' In Science Education For Seventh Graders In Riau*. *6*(2), 298–305. https://doi.org/10.15294/jpii.v6i2.10573