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Development of Simple Practicum Videos for Redox Materials as Alternative Practicums During the COVID-19 Pandemic

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Abstract: Due to COVID-19, media is needed so that students can continue to carry out practical activities at home to improve their understanding of chemical concepts. This study aimed to develop and determine the quality of a simple practicum video on redox material. This research is development research (R&D) with a 4D model (Define, Design, Development, and Disseminate), but this research is only up to the development stage. This simple video practicum on redox material contains the redox process on nail corrosion, the redox process on betadine with vitamin C, and the redox process on Onions with potassium permanganates. The product is assessed by one material expert, one media expert, four reviewers, and ten class X students respond. The results of the product quality assessment by material experts, media experts, and reviewers (senior high school chemistry teachers) get a percentage of 97.14%, 90%, and 91.81%, with a very good category. Then, the results of student responses obtained a percentage of 95% with a very good category. Based on this assessment, it can be concluded that simple practicum videos on redox material can be used as an alternative source of practicum during the COVID-19 era.

Keywords: Alternative practicum; Redox; Simple practicum video

Introduction

Activities in the laboratory cannot be carried out due to the COVID-19 pandemic (Anggrella et al., 2021). According to Zahro et al. (2021), practicum activities are essential for improving psychomotor, cognitive, and affective skills. Practicum is a teaching and learning activity to apply and strengthen mastery of the material carried out in the laboratory (Hendriyani et al., 2020; Suryaningsih, 2017). Practical activities can accommodate mastery of the material in mind and hands-on (Prayitno, 2017). Practicum is also helpful for answering curiosity about chemistry that is difficult to imagine in real (Lubis et al., 2016). However, due to COVID-19, practicum activities cannot be carried out in schools (Saraswati et al., 2020).

One solution for students to continue to do practicum is using tools and materials around the house (Darmayanti et al., 2021). Implementing the practicum at home to run smoothly requires media in the form of practicum videos. The practicum video is a video that contains the practicum process along with the tools and materials needed and how it works (Sugiharti et al., 2020). Based on interviews with senior high school chemistry teachers in Yogyakarta in April 2022, during pandemic COVID-9, there was no practicum at the schools to limit the spread of COVID-19. Students also do not do an independent practicum at home. Practical videos are practical and effective to be used as practicum media at home (Andreas et al., 2019). Practical videos have many advantages, namely developing students' imaginations, generating motivation, overcoming space and time limitations, and presenting actual reports (Rakhman et al., 2017). Practical videos can contain simple experiments using abundant natural materials in the surrounding environment to help increase students' understanding (Baunsele et al., 2020). However, according to Hofstein et al. (2004), the availability of

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practicum videos that are systematically arranged are not widely available in schools. One of the practicum videos whose availability is limited is the chemistry practicum video (Christianto et al., 2020).

Chemistry is a subject that can be understood through practical activities in the laboratory (Inayah et al., 2017). Chemistry requires understanding the scientific process, which must be done through practicum (Izzatunnisa et al., 2019; Ristiyani et al., 2016). Studying chemistry is focused on equipping students with knowledge, understanding, and skills (Umar, 2016). Students' positive perceptions of exciting and fun chemistry lessons are influenced by students who want to know more about chemistry (Nazhifah et al., 2015; Subagia, 2014). However, most students still consider chemistry lessons challenging to understand material and boring because they are abstract (Rosa, 2012). One of the chemistry materials that are difficult to understand and abstract is redox reactions (Salyani et al., 2018).

Redox reactions are materials that focus on differences in oxidation-reduction reactions and oxidation numbers (Putri et al., 2021). Redox materials are related to everyday life, such as respiration, photosynthesis, fuel combustion, photography, and metal refining (Yulianingtyas et al., 2017). The material has characteristics whose symptoms are concrete, and the concept is abstract (Pratiwi et al., 2014). In addition, redox material is difficult for students because there are concepts of electron transfer and changes in oxidation numbers that cannot be seen and imagined (Hidayati et al., 2019). Therefore, a simple practicum can be an excellent alternative to clarify material in redox reactions (Tiak et al., 2019). Based on the background explanation above, this study aims to develop a learning video in the form of a simple practicum video on redox material. Hopefully, this practicum video can be used as an alternative student practicum source at home to understand redox material better. This simple redox material practicum video is safe and easy to do at home because it uses tools and materials that are harmless and easy to find in the surrounding environment at affordable prices.

Method

This research is a research and development or Research and Development (R&D). This study uses a 4-D model (define, design, development, and disseminate) (Thiagarajan et al., 1974). However, this research is limited to the development stage only.

The define stage aims to collect data on needs analysis and concept analysis. A needs analysis was conducted by interviewing chemistry teachers and senior high school students. Concept analysis is done by analyzing the 2013 curriculum in chemistry. The design stage involves designing products according to the developed media, selecting formats, collecting references, and making instruments and initial designs. Development stage This is done to produce an excellent final video after going through revisions based on expert input and test data.

The subjects of this research include one material expert, one media expert, four reviewers (senior high school chemistry teachers), and ten senior high school students in class X who will respond to the product. The instruments used are product validation, product quality assessment, and student response sheets.

Data on the results of product quality assessments by media experts, material experts, and reviewers are processed by changing the results of qualitative assessments into quantitative ones using a Likert scale. Next, the average score is calculated using the following formula:

$$\bar{X} = \frac{\sum x}{n} \quad (1)$$

Information:

$\bar{X}$ = Average score
X = Total score of each rater
n = Number of raters

The score obtained is then calculated as the average score for the whole and each aspect of the assessment, then converted into a qualitative value according to the ideal assessment category as shown in Table 1 (Sukardjo et al., 2008).

Table 1. Criteria for Ideal Assessment Category

Score range (i) quantitative	Qualitative category
Xi + 1,8 SBi < X	Very Good
Xi + 0,6 SBi < X ≤ Xi + 1,8 SBi	Good
Xi – 0,6 SBi < X ≤ Xi + 0,6 SBi	Enough
Xi – 1,8 SBi < X ≤ Xi - 0,6 SBi	Less
X ≤ Xi – 1,80 SBi	Very Poor

Student response data is processed by converting qualitative data into quantitative data (scores) using the Guttman scale. The results of the assessments from media experts, material experts, reviewers, and student responses are then calculated as the ideal percentage using the formula:

$$Ideal\ percentage = \frac{scored\ reached}{ideal\ \max\ score} x\ 100\% \quad (2)$$

Result and Discussion

This research develops a practical video on redox material. Practical videos are needed to support the student learning at home (Parera et al., 2022). For editing

videos, use Adobe Premiere Pro and Adobe After Effects software because the facilities are complete and easy to use. Adobe Premiere Pro is used to edit, change the display pattern, and provide attractive transitions. Meanwhile, Adobe After Effects provides interesting special film effects because it is supported by a complete tool panel and is easy to improvise (Maharani et al., 2017). Adobe Premiere Pro is used to edit, change the display pattern, and provide attractive transitions (Zaini et al., 2020). Meanwhile, Adobe After Effects provides interesting special film effects because it is supported by a complete tool panel and is easy to improvise (Nurhardian et al., 2015).

This research adopts the 4D (define, design, development, and disseminate). The defined stage in this research includes needs analysis and concept analysis. Needs analysis was obtained by interviewing students and chemistry teachers of SMA Negeri 1 Banguntapan, SMA Negeri 5 Yogyakarta, and SMA Budi Luhur Yogyakarta. Based on the interview results, information was obtained that during the COVID-19 pandemic, there was no practicum carried out in the laboratory. Students need practicum to practice practical skills in the laboratory to understand better the concepts being taught. The existence of a practicum can also make students' memory of the material studied last longer. Video practicum is needed so that practicum activities are easy to do. Meanwhile, students think redox material is challenging to understand and imagine related to changes in oxidation numbers. Concept analysis identifies the primary material in the 2013 curriculum that will be developed in making media.

At the design stage, the initial product to be developed includes (1) media selection, (2) format selection, (3) reference collection, (4) instrument creation and data collection, and (5) initial design. The media and format developed in the form of a simple practicum video on redox material using tools and materials around the house. The reference material Furthermore, the making of an assessment instrument in the form of a quality assessment questionnaire with a Likert scale for material experts, media experts, and reviewers and student response sheets in the form of a Guttman scale for senior high school students in class X. This instrument was then consulted with the supervisor and further validated by the instrument expert. Making the initial design begins with making a storyboard to facilitate the design of the developed video content. The following are the stages of the process of making a simple, practical video.

The first stage is to prepare a video recording of redox practicum in daily life, namely a video of nail corrosion practicum, betadine with vitamin C, and red onion with PK. The second stage is editing using Adobe Premiere Pro, which can be seen in Figure 1.

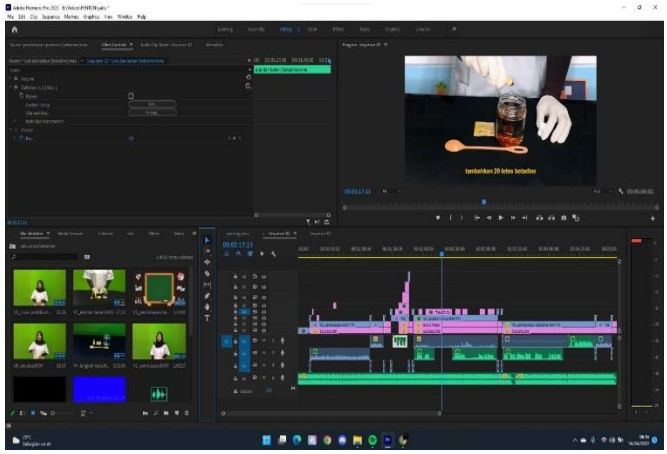

Figure 1. Video editing process in adobe premiere pro

In this stage, the process of merging *scenes* , giving sound and music, changing the *background* , and giving *subtitles* to the video so that it becomes a complete video that has information in it. Next, the video editing process using *Adobe After Effects* which can be seen in Figure 2.

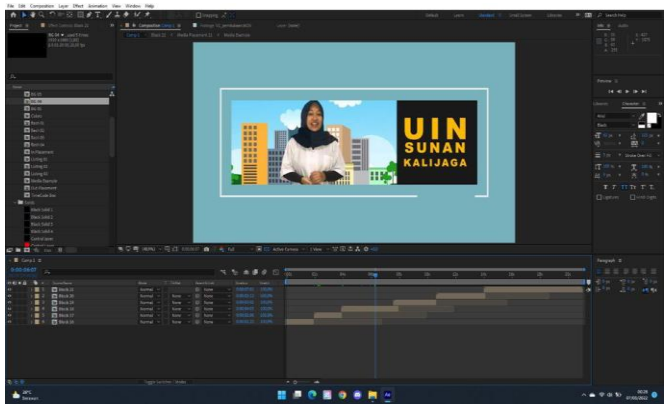

Figure 2. Video editing process

This stage is used to create an *opening* with a transition that contains snippets of video content. The third stage is to make a video containing material conclusions using the Canva application design program, which can be seen in Figure 3.

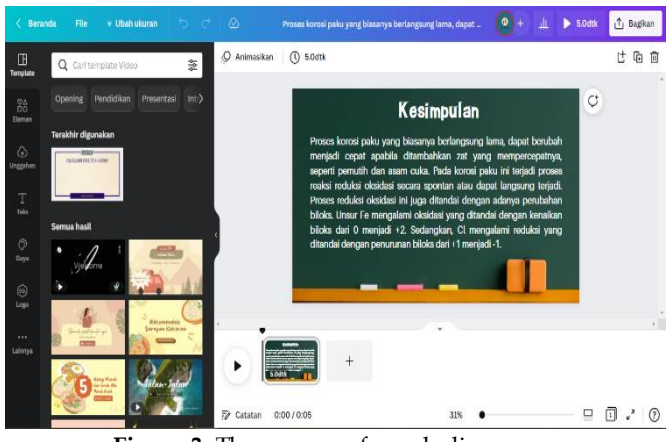

Figure 3. The process of concluding canva

The last stage is in the form of finishing. All videos edited, opened, and supported in the Canva application are combined into one using Adobe Premiere Pro and packaged more attractive. The final result of this video product is three simple practicum videos on redox material for ± 8 minutes. The components in the product consist of opening, content, and closing. The opening is a video opening or the initial appearance of a video made with exciting writing, transitions, and music. This opening contains an intro, video title, opening footage, core competencies, and essential competencies. The title of the video can be seen in Figure 4.

Figure 4. Video title

The content section contains four scenes of practicum activities: objectives, tools and practicum materials, work steps, discussions, and conclusions. The first scene is a practicum objective seen in Figure 5.

Figure 5. Practical purpose

Scene contains an introduction to tools and materials, as seen in Figure 6.

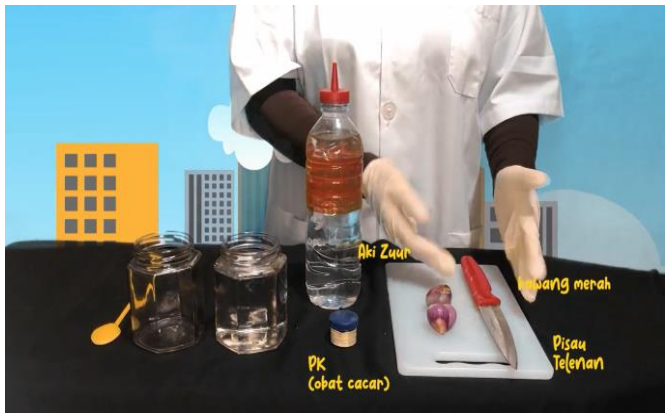

Figure 6. Introduction of tools and materials

Next, the third *scene* is the work step which can be seen in Figure 7.

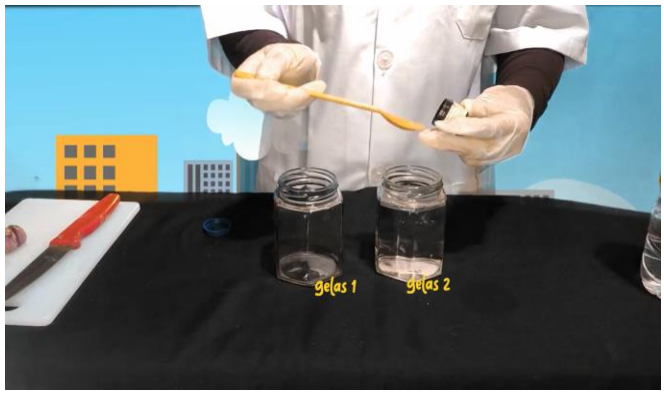

Figure 7 . Practical work steps

Then, the fourth *scene* is a discussion and practical conclusion. The practical conclusions can be seen in Figure 8.

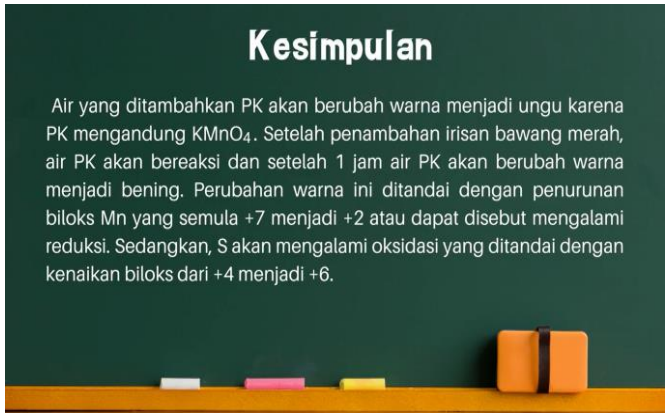

Figure 8. Practical Conclusion

Redox Process on Nail Corrosion

Corrosion is metal damage due to the reaction of the metal surface with an aqueous environment in the presence of oxygen (Ayu SA et al., 2015). In nail corrosion, an oxidation process occurs, forming rust (Saugi, 2021). The process of nail corrosion takes a long

time but can take place quickly if a substance that accelerates it is given, such as bleach and vinegar. Bleach (NaClO) can accelerate iron rust because its oxidizing properties can make it easier for iron to lose electrons. Vinegar acid can accelerate the occurrence of rust because hydrogen ions in the acid can remove electrons from iron (Thirumalai et al., 2020). The following is the nail corrosion process which can be seen in Figure 9.

Figure 9. Iron corrosion

In this reaction, Fe undergoes oxidation marked by an increase in oxidation number from 0 to +2. Meanwhile, Cl undergoes a reduction marked by a decrease in its oxidation number from +1 to -1.

Redox Process in Betadine with Vitamin C

Betadine contains iodine ions which are brownish-red in color. Vitamin C is a vitamin that contains ascorbic acid and is easily soluble in water (Fitriana et al., 2020). The redox reaction of betadine with vitamin C is that the iodine ion oxidizes vitamin C (Ika, 2012). The fading of the brownish-red color indicates the reduction of iodine (Aina et al., 2013). The following is the redox process for betadine with vitamin C which can be seen in Figure 10.

Figure 10. Betadine practicum with vitamin C

In this reaction, vitamin C undergoes oxidation which is indicated by an increase in the oxidation number from +2/3 to +1. Meanwhile, iodine is reduced, marked by a decrease in oxidation number from 0 to -1.

Redox Process on Onion with Potassium Permanganates (PK)

Onions contain active compounds like sulfur (Aryanta, 2019; Istina, 2016). Sulfur reacts with oxygen to form sulfur dioxide compounds (SO_2) (Cahyono, 2007). Potassium permanganate ($KMnO_4$) is an inorganic chemical compound found in medicines, especially itching drugs. Permanganate is a chemical compound containing manganate (VII) ions with a purple color. Mn has an oxidation number of +7, so it has strong oxidizing properties (Kumila et al., 2017). Manganese(VII) will be reduced by acid to become colorless with an oxidation number of +2. The color change of the redox process solution on the onion with PK can be seen in Figure 11.

Figure 11. Onion practicum with PK

In this reaction, Mangan (Mn) undergoes reduction with decreased oxidation number from +7 to +2. Sulfur (S) undergoes oxidation with an increased oxidation number from +4 to +6.

The development stage is the stage of product validation and assessment by material experts, media experts, and reviewers. Assessment of the quality of simple practicum videos on redox material by material experts covering content, language, practicum, and the role of practicum videos during the COVID -19 pandemic. The results of the video's quality assessment by material experts can be seen in Table 2.

Table 2 shows that according to material experts, the quality of simple practicum videos on redox material is in a very good category with an ideal percentage of 97.14% so that the material in the video can be used as an alternative learning resource during the COVID-19 pandemic. This study follows the research of (Mutia et al. (2018) that good video quality can be used as a learning resource. Furthermore, a simple practicum video quality assessment on redox material was carried out by media experts on the video aspect. The results of the practicum video quality assessment by media experts can be seen in Table 3.

Table 2. Product Quality Assessment by Material Experts

Assessment Aspect	Score	Max Score. Ideal	Ideal Percentage (%)	Category
Contents	14	15	93.33	Very good
Language	10	10	100	Very good
Practice	5	5	100	Very good
The role of practicum videos in the time of COVID-19	5	5	100	Very good
Total	34	35	97.14	Very good

Table 3 shows that according to media experts, the redox simple practicum video quality is in the very good category with an ideal percentage of 90%, so the video can be used as an alternative video for student practicum at home. This research suits Jundu et al. (2020), which state that video media can be used as an alternative guide for student practicum independently.

Table 3. Product Quality Assessment by Media Experts

Assessment Aspect	Score	Max Score. Ideal	Ideal Percentage (%)	Category
Videos	18	20	90	Very good
Total	18	20	90	Very good

Simple practicum videos on redox material have been validated and assessed for quality by material and media experts, then revised and assessed by reviewers. Reviewers assess the product from the aspect of content, language, practicum, the role of practicum videos during the COVID-19 pandemic, and videos. The following are the results of the assessment of simple practicum videos by reviewers, which can be seen in Table 4.

Table 4. Product Quality Assessment by Reviewers

Assessment Aspect	Score	Max Score. Ideal	Ideal Percentage (%)	Category
Contents	54	60	90	Very good
Language	37	40	92.5	Very good
Practice	20	20	100	Very good
The role of practicum videos in the time of COVID-19	20	20	100	Very good
Videos	71	80	88.75	Very good
Total	202	220	91.81	Very good

Table 4 shows that according to the reviewer, the redox simple practicum video quality is very good, with an ideal percentage of 91.81%, and is worthy of being used as an alternative learning resource during the COVID-19 pandemic. The assessment results suit the research of Putri et al. (2021), that learning videos can help teachers and students in learning and teaching activities. Hafizah (2020) says practicum videos can improve student learning outcomes.

Next, a trial was conducted on ten senior high school students in class X. Student responses played a role in assessing the media regarding material, presentation, practicum, role in the *COVID-19 era*, and benefits. The following are the results of student responses to simple practicum videos on redox material which can be seen in Table 5.

Table 5. Student Response

Assessment Aspect	Indicator	Score	Max Score. Ideal	Ideal Percentage (%)
Theory	2	19	20	95%
Presentation	2	19	20	95%
Practice	2	17	20	85%
Role in the time of covid-19	2	20	20	100%
Benefit	2	20	20	100%
Total	10	95	100	95%

Based on the results of student responses, the ideal percentage is 95% so that simple, practical videos on redox material can be used as learning resources during the COVID-19 pandemic. According to Ardiman et al. (2021), students' responses to practicum-based media with very good assessment results are worthy of being used as alternative media in learning. Therefore, the learning media in the form of a simple practicum video

on redox material is suitable to be used as a source of student learning. The constraint in making this video is in the editing of changing the background, where changing the background from the green screen is one of the problematic parts of video editing. Besides the camera angle, lighting settings also play an essential role in the resulting video.

Conclusion

Based on the research, a redox reaction practicum video consisted of corrosion practicum on nails, betadine with vitamin C, and Onions with potassium permanganates. The videos developed have evident visual characteristics, easy-to-understand language, and are easy to apply in everyday life. Based on the results of video assessments by material experts of 97.14% in the very good category, media experts by 90% in the very good category, and reviewers 91.81% in the very good category. Furthermore, based on student responses, students get a percentage of 95 % with a very good category, so simple practicum videos on redox material can be used as an alternative source of practicum during the COVID-19 pandemic.

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Author Contributions
Khairunnisa Nurul Laily contributes to conceptualizing the research idea, developing products, analyzing data, and writing articles. Agus Kamaludin, a supervisor in research activities to article writing, reviewed and edited.

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Conflicts of Interest
The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Aina, M., & Suprayogi, D. (2013). Uji kualitatif vitamin c pada berbagai makanan dan pengaruhnya terhadap pemanasan. *Journal of Chemical Information and Modeling*, *53*(1), 1689–1699. Retrieved from https://media.neliti.com/media/publications/221096-uji-kualitatif-vitamin-c-pada-berbagai-m.pdf

Andreas, L. O., & Gusmareta, Y. (2019). Pengembangan media pembelajaran mata kuliah mekanika tanah dan teknik pondasi berbasis video tutorial. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699. https://doi.org/10.24036/cived.v5i4.102721

Anggrella, D. P., Rahmasiwi, A., & Purbowati, D. (2021). Eksplorasi kegiatan praktikum IPA PGMI selama pandemi COVID-19. *SAP (Susunan Artikel Pendidikan)*, *6*(1). https://doi.org/10.30998/sap.v6i1.9612

Ardiman, K., Tukan, M. B., & Baunsele, A. B. (2021). Pengembangan Video Pembelajaran Berbasis Praktikum Dalam Pembelajaran Daring Materi Titrasi Asam Basa Kelas XI SMAN 5 Pocoranaka. *Jurnal Beta Kimia*, *1*(1), 22–28. Retrieved from https://ejurnal.undana.ac.id/index.php/jbk/article/view/5130

Aryanta, I. W. R. (2019). Bawang Merah dan Manfaatnya Bagi Kesehatan. *Widya Kesehatan*, *1*(1), 29–35. https://doi.org/10.32795/widyakesehatan.v1i1.280

Ayu, G. A. P., Rahmayanti, D., & Nindy, E. M. (2015). Perhitungan Laju Korosi di dalam Larutan Air Laut dan Air Garam 3% pada Paku dan Besi ASTM A36. *Jurnal Untirta*, *2*(4), 6–12. https://doi.org/10.30870/gravity.v1i1.2489

Baunsele, A. B., Tukan, M. B., Kopon, A., Boelan, E. G., Komisia, F., Leba, M., & Lawung, Y. (2020). Peningkatan pemahaman terhadap ilmu kimia melalui kegiatan praktikum kimia sederhana di kota Soe. *Jurnal Pengabdian Kepada Mayarakat (Aptekmas)*, *3*(4), 43–48. https://doi.org/10.36257/apts.vxix

Cahyono, E. W. (2007). Pengaruh Hujan Asam pada Biotik dan Abiotik. *Berita Dirgantara*, *8*(3), 48. Retrieved from http://jurnal.lapan.go.id/index.php/berita_dirgantara/article/download/718/636

Christianto, H., Silaban, R., & Jahro, I. S. (2020). Standarisasi penuntun praktikum interaktif berbasis multimedia untuk materi kimia larutan di SMA. *Prosiding Seminar Nasional Pendidikan Dan Sains Kimia (SNP-SK) FKIP-Undana*, *3*(1), 48–57. Retrieved from https://conference.undana.ac.id/WNPSK/article/view/99%0Ahttps://conference.undana.ac.id/WNPSK/article/download/99/83

Darmayanti, N. W. S., & Numertayasa, I. W. (2021). Pendampingan Bimbingan Belajar Praktikum Sederhana Berorientasikan Lingkungan Sekitar Untuk Anak SD pada Masa Pandemi Covid-19. *SELAPARANG Jurnal Pengabdian Masyarakat Berkemajuan*, *4*(3), 928. https://doi.org/10.31764/jpmb.v4i3.5416

Fitriana, Y. A. N., & Fitri, A. S. (2020). Analisis Kadar Vitamin C pada Buah Jeruk Menggunakan Metode Titrasi Iodometri. *Sainteks*, *17*(1), 27. https://doi.org/10.30595/sainteks.v17i1.8530

Hendriyani, M. E., & Novi, R. (2020). Laporan Praktikum Mandiri Dalam Bentuk Video Presentasi Untuk

Mengembangkan Kreativitas Dan Komunikasi Lisan Di Masa Pandemi Covid-19. *Prosiding Seminar Nasional Pendidikan FKIP Universitas Sultan Ageng Tirtayasa*, *3*(1), 328–339. Retrieved from https://pustaka.untirta.ac.id/index.php/psnp/article/view/9948

Hidayati, U. N., & Sumarti, S. S. (2019). Desain instrumen tes three tier multiple choice untuk analisis pemahaman konsep peserta didik. *Inovasi Pendidikan Kimia*, *13*(2), 2425–2436. https://doi.org/10.15294/jipk.v13i2.19382

Hofstein, A., & Lunetta, V. N. (2004). The laboratory in science education: Foundations for the twenty-first century. *Science Education*, *88*(1), 28–54. https://doi.org/10.1002/sce.10106

Ika, D. (2012). Alat Otomatisasi Pengukur Kadar Vitamin C dengan Metode Titrasi Asam Basa. *Jurnal Neutrino*, *1*(2), 163. https://doi.org/10.18860/neu.v0i0.1634

Inayah, L., & Astuti, A. P. (2017). Analisis tingkat keberhasilan pembelajaran laboratorium dalam pelajaran kimia di SMA Negeri 9 Semarang. *Universitas Muhammadiyah Semarang*, 200–207. Retrieved from https://jurnal.unimus.ac.id/index.php/psn12012010/article/view/3060/2969

Istina, I. N. (2016). Peningkatan Produksi Bawang Merah Melalui Teknik Pemupukan NPK. *Jurnal Agro*, *3*(1), 36–42. https://doi.org/10.15575/810

Izzatunnisa, I., Andayani, Y., & Hakim, A. (2019). Pengembangan LKPD Berbasis Pembelajaran Penemuan Untuk Meningkatkan Kemampuan Literasi Sains Peserta Didik Pada Materi Kimia SMA. *Jurnal Pijar Mipa*, *14*(2), 49–54. https://doi.org/10.29303/jpm.v14i2.1240

Jundu, R., Nendi, F., Kurnila, V. S., Mulu, H., Ningsi, G. P., & Ali, F. A. (2020). Pengembangan Video Pembelajaran IPA Berbasis Kontekstual di Manggarai untuk Belajar Siswa pada Masa Pandemic Covid-19. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *10*(2), 63–73. https://doi.org/10.24929/lensa.v10i2.112

Kumila, B. N., & Liu, C. (2017). Analisa pengaruh reduksi termal terhadap kerusakan struktur (structural-disorder) pada lapisan tipis graphene oxide tereduksi. *Jurnal Fisika Dan Aplikasinya*, *2*(1). https://doi.org/10.21009/SPEKTRA

Lubis, L. T., Silaban, R., & Jahro, I. S. (2016). Pengembangan penuntun praktikum kimia dasar I terintegrasi pendekatan inkuiri. *Jurnal Pendidikan Kimia*, *8*(2), 95–104. https://doi.org/10.24114/jpkim.v8i2.4435

Maharani, D., & Hotami, M. (2017). Rendering video advertising dengan adobe after effects dan photoshop. *Jurnal Manajemen Informatika Dan Teknik Komputer*, *2*, 105–111. https://doi.org/10.31227/osf.io/3nehj

Mutia, R., Adlim, A., & Halim, A. (2018). Pengembangan Video Pembelajaran IPA pada Materi Pencemaran Dan Kerusakan Lingkungan. *Jurnal Pendidikan Sains Indonesia*, *5*(2), 108–114. https://doi.org/10.24815/jpsi.v5i2.9825

Nazhifah, S., Copriady, J., & Herdini. (2015). Hubungan persepsi siswa tentang pelajaran kimia dengan hasil belajar kimia siswa SMA Negeri 9 Pekanbaru. *Jurnal Online Mahasiswa (JOM) Bidang Keguruan Dan Ilmu Pendidikan*, *2*(1), 1–8. Retrieved from https://jom.unri.ac.id/index.php/JOMFKIP/article/view/5825

Nurhardian, T., Ferdiansyah, R., & Dwiyatno, S. (2015). Iklan Layanan Masyarakat Tentang Tertib Berlalu Lintas Di Kota Rangkas Bitung Dengan Menggunakan Adobe Premiere Dan Adobe After Effect. *Jurnal Sistem Komputer*, *2*(1), 76–92. Retrieved from https://e-jurnal.lppmunsera.org/index.php/PROSISKO/article/view/98/157

Parera, L. A. M., Christianto, H., & Lazar, A. P. P. (2022). Pengembangan Video Pembelajaran dengan Bantuan Software Wondershare Filmora pada Materi Reaksi Reduksi Oksidasi. *Jurnal Inovasi Pembelajaran Kimia*, *4*(1), 74. https://doi.org/10.24114/jipk.v4i1.33649

Pratiwi, Y., Redjeki, T., & Masykuri, M. (2014). Pelaksanaan Model Pembelajaran Problem Based Learning (Pbl) Pada Materi Redoks Kelas X Sma Negeri 5 Surakarta Tahun Pelajaran 2013/2014. *Jurnal Pendidikan Kimia Universitas Sebelas Maret*, *3*(3), 40–48. Retrieved from https://jurnal.fkip.uns.ac.id/index.php/kimia/article/view/4200

Prayitno, T. A. (2017). Pengembangan petunjuk praktikum mikrobiologi program studi pendidikan biologi. *Biota*, *3*(1), 31. https://doi.org/10.19109/biota.v3i1.1041

Putri, T. C., Sugiarti, Y., & Garnadi, G. (2021). Pengembangan media pembelajaran video praktikum untuk meningkatkan hasil belajar peserta didik development of practical work video learning media to improve student learning outcomes. *EDUFORTECH*, *6*(2). https://doi.org/10.17509/edufortech.v6i2.39292

Rakhman, K. A., Saraha, A. R., & Sugrah, N. (2017). Pengembangan video penggunaan alat gelas laboratorium kimia di Universitas. *Jurnal Inovasi Pendidikan IPA*, *3*(2), 161. https://doi.org/10.21831/jipi.v3i2.15667

Ristiyani, E., & Bahriah, E. S. (2016). Analisis kesulitan belajar kimia siswa di SMAN X Kota Tangerang Selatan. *Jurnal Penelitian Dan Pembelajaran IPA*, *2*(1),

18. https://doi.org/10.30870/jppi.v2i1.431

Rosa, N. M. (2012). Pengaruh sikap pada mata pelajaran kimia dan konsep diri terhadap prestasi belajar kimia. *Formatif*, *2*(3), 234979. https://doi.org/10.30998/formatif.v2i3.104

Salyani, R., Amsal, A., & Zulyani, R. (2018). Pengembangan buku saku pada materi reaksi reduksi oksidasi (redoks) di MAN model Banda Aceh. *Jurnal IPA & Pembelajaran IPA*, *2*(1), 7–14. https://doi.org/10.24815/jipi.v2i1.10736

Saraswati, N. L. P. A., & Mertayasa, I. N. E. (2020). Pembelajaran praktikum kimia pada masa pandemi COVID-19: qualitative content analysis kecenderungan pemanfaatan teknologi daring. *Wahana Matematika Dan Sains: Jurnal Matematika, Sains, Dan Pembelajaran.*, *14*(2), 144–161. https://doi.org/10.23887/wms.v14i2.28297

Saugi, W. (2021). Pengaruh Faktor Fisik, Kimia, dan Biologi Medium Terhadap Laju Korosi Besi. *Borneo Journal of Science and Mathematics Education*, *1*(1), 29–55. Retrieved from https://journal.uinsi.ac.id/index.php/bjsme/article/view/3140

Subagia, I. W. (2014). Paradigma Baru Pembelajaran Kimia SMA. *Seminar Nasional FMIPA UNDIKSHA IV*. Retrieved from https://ejournal.undiksha.ac.id/index.php/semnasmipa/article/view/10479

Sugiharti, S., & Sugandi, M. K. (2020). Laboratorium Virtual: Media Praktikum Online untuk Meningkatkan Pemahaman Siswa di Masa Pandemi. *Seminar Nasional Pendidikan*, 45–51. Retrieved from https://prosiding.unma.ac.id/index.php/semnasfkip/article/view/299

Sukardjo, & Sari, L. P. (2008). *Penilaian hasil belajar kimia*. Yogyakarta: UNY Press.

Suryaningsih, Y. (2017). Pembelajaran berbasis praktikum sebagai sarana siswa untuk berlatih menerapkan keterampilan proses sains dalam materi biologi. *Jurnal Bio Education*, *2*(2), 49–57. https://doi.org/10.31949/be.v2i2.759

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). *Instructional development for training teacher of exceptional children*. Indiana University.

Thirumalai, M., Jesuraja, B. B., & Paulraj, P. (2020). Effects Of Salt , Vinegar And Bleach In Accelerating Rusting Of Iron. *International Journal of Innovative Research and Advanced Studies (IJIRAS)*, *7*(6), 20–26. Retrieved from https://www.ijiras.com/2020/Vol_7-Issue_6/paper_3.pdf

Tiak, L., Tani, D., & Caroles, J. D. S. (2019). Penerapan metode praktikum berbasis bahan alam dalam pembelajaran kimia untuk meningkatkan hasil belajar siswa pada materi reaksi redoks. *Oxygenius Journal Of Chemistry Education*, *1*(1), 1–4. https://doi.org/10.37033/ojce.v1i1.95

Umar, M. A. (2016). Penerapan pendekatan saintifik dengan metode pembelajaran berbasis proyek (project-based learning) pada mata pelajaran kimia. *Jurnal Entropi*, *11*(2), 132–138. Retrieved from https://rb.gy/vir0yl

Yulianingtyas, E., Budiasih, E., & Marfuah, S. (2017). Pengaruh penggunaan jurnal belajar dalam model pembelajaran learning cycle 6E terhadap kesadaran metakognitif siswa SMAN 8 Malang pada materi redoks. *Teori, Penelitian, Dan Pengembangan*, *2*(5), 724–730. https://doi.org/10.17977/jptpp.v2i5.9203

Zahro, N. F., & Pertiwi, F. N. (2021). Eksplorasi : Praktikum DDR Sebagai Bentuk Adaptasi Kebiasaan. *PISCES: Proceeding of Integrative Science Education Seminar*, *1*, 70–77. Retrieved from https://prosiding.iainponorogo.ac.id/index.php/pisces/article/view/186

Zaini, M. S., & Nugraha, J. (2020). Pengembangan Media Pembelajaran Multimedia Interaktif Berbasis Adobe Premiere Pro Pada Kompetensi Dasar Mengelola Kegiatan Humas Kelas XI Administrasi Perkantoran di SMK Negeri 2 Buduran Sidorajo. *Jurnal Pendidikan Administrasi Perkantoran (JPAP)*, *9*(2), 349–361. https://doi.org/10.26740/jpap.v9n2.p349-361