JPPIPA 9(Special Issue) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Electronic Portfolio Assessment Strategy Using Google Classroom to Improve Students' Abilities in Learning Chemistry

Nuryanto[1*], Nahadi[1]

[1] Chemistry Education Department, Universitas Pendidikan Indonesia, Bandung, Indonesia.

Received: October 7, 2023
Revised: November 18, 2023
Accepted: December 25, 2023
Published: December 31, 2023

Corresponding Author:
Nuryanto
nuryanto28@upi.edu

DOI: 10.29303/jppipa.v9iSpecialIssue.6162

Abstract: This research aims to determine electronic portfolio assessment strategies using Google Classroom to improve students' abilities in learning chemistry. Assessment is an important aspect of learning to measure students' abilities. Characteristics of chemical material that contains calculations and concepts and has connections between concepts, requires the ability to master concepts and critical thinking skills of students in learning chemistry. Electronic portfolio assessment using Google Classroom is one of the uses of technology in the field of education. The method used in this research is a survey method. This research involved ten (10) high school chemistry teachers from various schools in Sumedang Regency. The data collection technique uses a questionnaire with qualitative data type. The research results show that teachers have implemented various types of assessment in chemistry learning. However, only 70% of teachers have implemented electronic portfolio assessment and it is not optimal. In using chemistry learning media, all teachers have used the application Google Classroom. In terms of students' abilities, both the ability to master chemical concepts and critical thinking skills are still quite low. The conclusion in this research is an electronic portfolio assessment using Google Classroom can be an alternative to improve students' abilities in learning chemistry.

Keywords: Electronic Portfolio Assessment; Critical Thinking Skills; Google Classroom

Introduction

In the learning process, assessment is an important aspect that must be considered (Permatasari et al., 2023). Assessment is an important aspect that must be carried out because it is used as a tool to assess students' abilities (Sartika & Yusmaita, 2020). According to Sulistyawati (2021), good assessment is not only concerned with the final result, but must also consider the process carried out by students. One assessment that emphasizes the learning process is portfolio assessment (Rikizaputra et al., 2021).

The portfolio contains a collection of students' work which is arranged systematically and organized as a result of the learning process that has been carried out (Ismail, 2020). This collection of works is used as information by teachers and students to reflect (Karyono, 2022). With feedback from the teacher, portfolio assessment can be an alternative in improving students' abilities (Haruna et al., 2018). In accordance with Kasang (2022) research results, it is stated that portfolio assessment can improve students' abilities.

Portfolio assessments have several weaknesses, as explained by Supriani & Ubabuddin (2023), portfolio assessments require extra time compared to other assessments and require more storage space. This problem can be overcome using digital technology in the form of electronic portfolios (Periadi et al., 2018).

How to Cite:
Nuryanto, & Nahadi. (2023). Electronic Portfolio Assessment Strategy Using Google Classroom to Improve Students' Abilities in Learning Chemistry. *Jurnal Penelitian Pendidikan IPA*, *9*(SpecialIssue), 885–892. https://doi.org/10.29303/jppipa.v9iSpecialIssue.6162

Electronic portfolio assessment contains a collection of evidence of students' work using electronic devices or technology (Rahayu & Wulandari, 2021). Electronic portfolio assessment is more flexible than conventional portfolio assessment because it can be used anytime and anywhere (Song, 2021). Apart from that, Masluhah & Afifah (2022) stated that electronic portfolio assessment can use varied assignment formats, can be stored for a long time, reduces assignment storage space and makes it easier for students to collect assignments.

Electronic portfolio assessment is one of the uses of technology in the educational sector that uses Learning Management System (LMS) (Hakim et al., 2020). LMS provides an online folder for learning management, where teachers can post materials and assignments while students can participate in learning by accessing materials and collecting assignments (Abazi-Bexheti et al., 2018). One of the LMS applications that are available and widely used is Google Classroom, an application from Google Apps for Education which is free and easy to use (Dash, 2019). Google Classroom has many advantages, including saving time because the Google Classroom setting process is very fast and easy to use, no need to use paper or paperless, helps distance learning, increases collaboration and communication without time limits, and has large data storage (Sudarsana et al., 2019).

The results of research conducted by Asari et al. (2022) and Eti (2021), state that there is an increase in learning outcomes by using Google Classroom in chemistry learning. Ni (2020) also explains the implementation of learning using Google Classrom able to improve students' ability to obtain the information obtained. Apart from that, the research results of Danurahman & Arif (2021) stated that the use of Google Classroom can improve students' critical thinking skills. Critical thinking skills are one of the skills that students should have in the 21st century (Hidayat et al., 2022). According to Danczak et al. (2017), critical thinking skills can be developed in learning certain scientific disciplines. In chemistry learning, critical thinking skills are very necessary for students because they are used in collecting and analyzing data to arrive at conclusions (Stephenson et al., 2019). Chemical material has the characteristic that it contains concepts and calculations and has connections between concepts, so students need critical thinking skills and mastery of concepts.

So far there has been no research that examines the use of electronic portfolio assessment using Google Classroom to improve critical thinking skills and mastery of concepts in chemistry learning. Therefore, researchers feel it is necessary to examine electronic portfolio assessment strategies using Google Classroom to improve students' abilities which include critical thinking skills and mastery of concepts in chemistry learning.

Method

The method used in this research is a survey method. According to Haddar et al. (2023), the survey method in education is a descriptive research method for collecting, displaying data from existing phenomena and finding facts about various problems in the field of education. The subjects of this research involved ten high school chemistry teachers from various schools in Sumedang Regency who were chosen randomly (random sampling). The data collection technique uses a questionnaire with qualitative data type. The questionnaire was distributed using Google Form to fill in the response online. The data from the questionnaire was then analyzed to determine teachers' needs for electronic portfolio assessments in chemistry learning to improve students' abilities using Google Classroom.

Result and Discussion

Result

Question 1: What types of assessments have you implemented in learning chemistry?

In this question, all respondents have implemented various types of assessments in learning chemistry. There were various answers that emerged regarding the assessments used by respondents in learning chemistry, namely written assessments, project assessments, performance assessments, and portfolio assessments. The most widely used answer results are written assessments.

Question 2: Have you ever implemented portfolio assessment in learning chemistry?

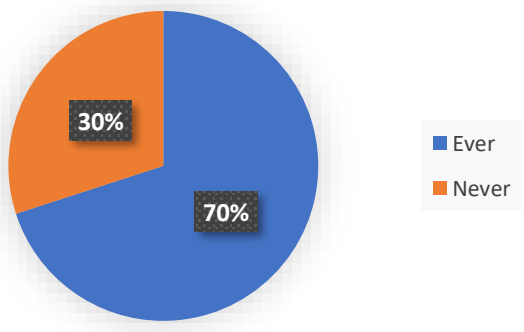

Figure 1. Implementation of Portfolio Assessment

Based on the results of the questionnaire answers, 70% of respondents had implemented portfolio assessments in learning chemistry. Respondents who had implemented portfolio assessments stated that the

implementation was carried out by making reports on the results of practicum activities and collecting student assignments for a certain period. Respondents who had never implemented a portfolio assessment (as many as 30%) said that there would be a lot of portfolio files piling up so they did not carry out a portfolio assessment. Apart from that, there are those who still have no experience regarding portfolio assessment.

Question 3: After carrying out the assessment, do you always provide feedback on the assignments that students have completed?

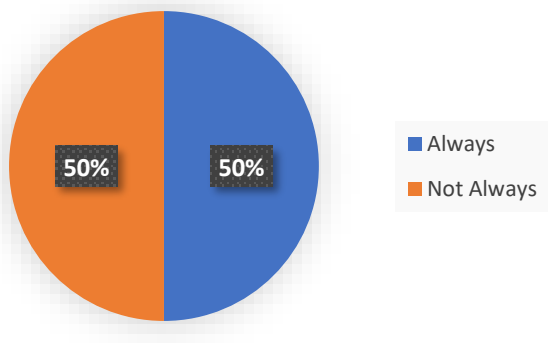

Figure 2. Giving Feedback

As many as 50% of respondents always give feedback of the assignments that students have completed. One respondent said that giving feedback the results of students' work is a form of appreciation and to avoid misconceptions or misunderstandings of students' chemical concepts. As many as 50% of respondents do not always give feedback on students' work.

Question 4: What are the obstacles in giving feedback?

All respondents stated that there were obstacles in giving feedback There are too many students' work so it will take a lot of time to giving comments.

Question 5: Are you familiar with electronic portfolio assessment?

As many as 80% stated that they knew about electronic portfolio assessment and the remaining 20% still did not know.

Question 6: Have you ever implemented electronic portfolio assessment in learning chemistry?

As many as 70% stated that they had implemented electronic portfolio assessments in learning chemistry and the remaining 30% had never.

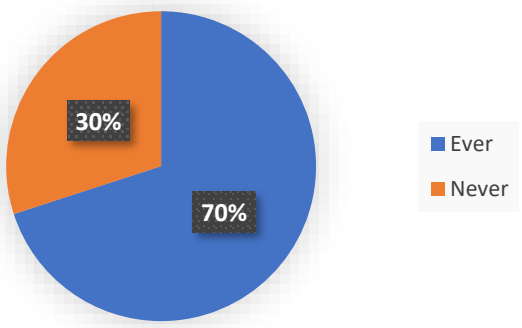

Figure 3. Implementation of Electronic Portfolio Assessment

Question 7: Have you ever used Google Classroom in learning chemistry?

Based on the results of the questionnaire answers, all respondents had used Google Classroom in learning chemistry.

Question 8: Have you ever used Google Classroom to carry out assessments?

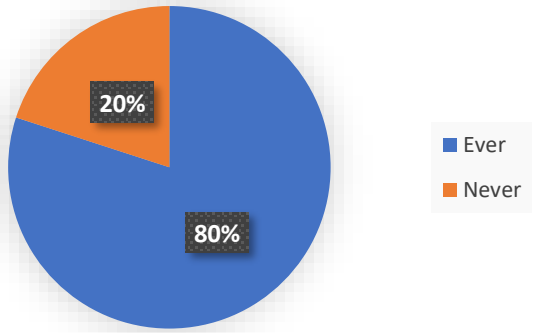

Figure 4. Using Google Classroom in Assessment

Question 9: What are the obstacles in using Google Classroom?

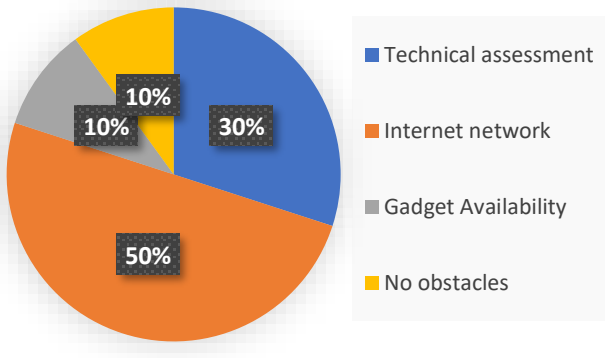

Figure 5. Obstacles to using Google Classroom

It turns out that using Google Classroom in learning still has obstacles. There were several obstacles conveyed by respondents from the results of the

questionnaire answers, namely 50% answered internet network problems, 30% answered obstacles in technical assessment, 10% said there were problems with the availability of students' gadgets and 10% said there were no problems in using Google Classroom.

Question 10: What is the ability of students to master concepts in learning chemistry at school?

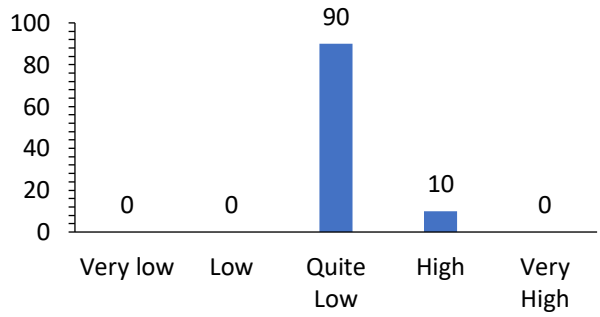

Figure 6. Mastery of Concepts in Learning Chemistry

As many as 90% of respondents stated that students' ability to master chemistry concepts at school was quite low and only 10% said it was high.

Question 11: What are the critical thinking skills of students in learning chemistry at school?

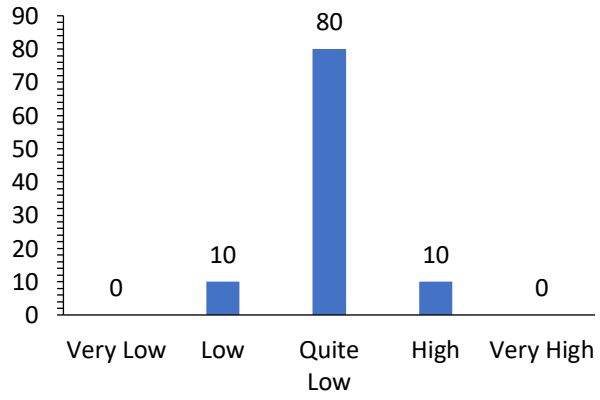

Figure 7. Critical Thinking Skills in Learning Chemistry

Judging from students' critical thinking skills in chemistry learning, 10% of respondents said it was still low, 90% of respondents said it was quite low, and only 10% of respondents said it was high.

Discussion

There are various types of assessments that respondents use in learning chemistry, namely written assessments, project assessments, performance assessments, and portfolio assessments. However, the answer most frequently used by respondents was written assessment. This shows that respondents still widely use written assessments in learning chemistry. Syam (2020) stated that the dominant use of written test assessments in learning is still not optimal for determining students' abilities. According to Nahadi & Firman (2019), a combination of various types of assessments is needed to obtain information on students' abilities. Portfolio assessment is a type of assessment that can be concrete and valid evidence in obtaining information on students' understanding of concepts (Amanda et al., 2022). Apart from that, the use of portfolio assessment can also improve students' critical thinking skills (Syzdykova et al., 2021).

As many as 70% of respondents have implemented portfolio assessment in learning chemistry. According to the results of the questionnaire, the obstacle for teachers in carrying out portfolio assessments is the large number of portfolio files that will accumulate. This is in line with research by Juhanda et al. (2015), one of the weaknesses of conventional portfolio assessment is that it requires a lot of space to store student assignment files. As many as 20% of respondents have not implemented portfolio assessments because they still have no experience with portfolio assessments.

One of the advantages of portfolio assessment is that it can see the development of students' abilities based on feedback given by the teacher (Farihah, 2021). As many as 50% of respondents always give feedback of the assignments that students have completed. Respondents stated that giving feedback is a form of appreciation and to avoid misconceptions or misunderstandings of chemical concepts in learning. As many as 50% still have not fully delivered feedback to student assignments. Obstacles in giving feedback is a pile of participant assignment documents so that it will take a lot of time to provide comments. This problem can be overcome by implementing electronic portfolio assessment (Wijayanti & Basyar, 2016). Electronic portfolios can better accommodate the increasing range of assessments and are more flexible than conventional portfolios (Nurhayati & Sumbawati, 2020). As many as 80% of respondents already knew about electronic portfolio assessment, but only 70% of respondents had ever implemented electronic portfolio assessment in learning chemistry.

One of the LMS (Learning Management System) applications which is widely used in learning, namely Google Classroom. This can be seen from the answers of all respondents who stated that they had used Google Classrom in chemistry learning. The research results of Rosa & Suryadi (2022) also state that there is an increase in learning chemistry outcomes with using Google Classroom. However, all this time Google Classroom more widely used only as a learning tool. As many as

20% of respondents have not used Google Classrom as a means of assessment. This means that not all teachers using Google Classroom as a means of assessment. Whereas Google Classroom has many interesting features, one of which is the easy task collection feature (Andewi & Pujiastuti, 2021). Besides that, Google Classroom integrated with other product applications from Google which can support the use of this application. Thus, it is necessary to carry out research on utilization Google Classroom as a means of assessment.

Although the application Google Classroom has been widely used, but it turns out teachers still have several obstacles in using it. As many as 50% of respondents answered that there were internet network problems, 30% answered that there were problems with technical assessment, 10% said there were problems with the availability of students' gadgets and 10% said there were no problems in using Google Classroom. On the other hand, the rapid development of information technology in the 21st century has a great influence on the world of education (Sole & Anggraeni, 2018). One influence that can be felt is the use of computer and internet technology in learning or what is called electronic-based learning. Use Google Classroom become one form of application of electronic learning. Teachers and students are required to master the use of information technology. Therefore, teachers need to prepare students to be able to adapt in using technology and information according to developments in science and technology.

Apart from technology and information skills, the skills that students must master in the 21st century are communication skills, collaboration skills, critical thinking skills and problem solving (Rahmawati et al., 2019). One part of higher-level thinking that is the main concern of education in the 21st century is critical thinking skills (Kriswantoro et al., 2021). Critical thinking skills in learning chemistry are needed in analyzing emerging chemical symptoms or phenomena (Manik et al., 2020). Judging from the results of the questionnaire, 10% of respondents said their critical thinking skills in learning chemistry were still low, 90% of respondents said they were quite low, and only 10% of respondents said they were high.

Chemical material has the characteristics of being computational and containing concepts and relationships between concepts, so students need the ability to master chemical concepts. From the results of the questionnaire, as many as 90% of respondents stated that students' ability to master chemistry concepts at school was quite low and only 10% said it was high. Judging from the results of the questionnaire, the average students' ability to master concepts and critical thinking skills is still quite low. Thus, there needs to be a strategy to improve students' abilities, both the ability to master concepts and critical thinking skills. Students' abilities can not only be developed through learning, but can be developed and improved through assessment (Hasan et al., 2020).

Electronic portfolio assessment is an alternative that can be implemented to measure students' abilities in accordance with the digital era. The research results of Juhanda et al. (2015), shows that portfolio assessment can improve students' mastery of concepts. Research by Syzdykova et al. (2021), states that the use of electronic portfolio assessments can improve students' critical thinking skills. The advantage of electronic portfolio assessments is that teachers can give them immediately feedback towards student assignments. Thus, students can immediately carry out self-assessment from feedback which has been given by the teacher. After getting feedback from the teacher, students can return assignments that have been corrected. This process can improve students' abilities (Kurniawan et al., 2022). This activity can be carried out via the Google Classroom application.

Google Classroom can help in deeper teaching and learning activities, because students can collect assignments, while teachers can distribute assignments and assess assignments wherever and whenever (Bintarawati & Citriadin, 2020). Delivery of material through features of Google Classroom can help students to construct their mastery of concepts, thereby enabling students to process critical thinking better and continuously (Patimah et al., 2021). Electronic portfolio assessment strategy using Google Classroom is expected simplify the assessment process in learning chemistry. Apart from that, giving feedback from educators and self-assessments carried out by students which can be done through the features in Google Classroom is also expected to improve students' ability to master concepts and critical thinking skills in learning chemistry.

Conclusion

Teachers have implemented various types of assessments in learning chemistry. As many as 70% of teachers have implemented portfolio assessments, both conventional portfolio assessments and electronic portfolio assessments, but their implementation is still not optimal. In using information technology, all teachers have used *Google Classroom* applications in learning chemistry. Using *Google Classroom*, the teacher can give feedback to make improvements to assignments that have been submitted. This process is carried out continuously so that it can develop students' abilities. In terms of students' abilities, both the ability to master chemical concepts and critical thinking skills are

still quite low. The conclusion in this research is an electronic portfolio assessment using *Google Classroom* can be an alternative to improve students' abilities in learning chemistry.

Acknowledgments
The author would like to thank all parties who have contributed to this research. I hope that the results of this research can be useful for teachers and all educational stakeholders in improving the quality of learning, especially in learning chemistry.

Author Contributions
All authors were involved in writing this article.

Funding
This research received no external funding.

Conflicts of Interest
The author declares that there is no conflict of interest regarding the publication of this article.

References

Abazi-Bexheti, L., Kadriu, A., Apostolova-Trpkovska, M., Jajaga, E., & Abazi-Alili, H. (2018). LMS Solution: Evidence of Google Classroom Usage in Higher Education. *Business Systems Research*, *9*(1), 31–43. https://doi.org/10.2478/bsrj-2018-0003

Amanda, A., Anggela, C. A., Febrianti, F. M. D., Amalia, N., & Siwi, N. S. W. (2022). Tinjauan Literatur: Pengaruh Penerapan Asesmen Berbasis Portofolio terhadap Pemahaman Materi Pelajaran Sekolah pada Siswa SMA. *Seminar Nasional Psikologi dan Ilmu Humaniora (SENAPIH)*, *1*(1), 116–123.

Andewi, W., & Pujiastuti, D. (2021). Google Classroom: The Web-Based Media for Teaching English. *Jurnal Penelitian Ilmu Pendidikan*, *14*(2), 189–198. https://doi.org/10.21831/jpipfip.v14i2.41450

Asari, D., Zakir, S., Sesmiarni, Z., & Melani, M. (2022). Hubungan Pemanfaatan Google Classroom terhadap Hasil Belajar Kimia di SMA Negeri 1 Minas. *Jurnal Ilmiah Multidisiplin Indonesia*, *2*(1), 176–182.

Bintarawati, D., & Citriadin, Y. (2020). Implementasi Kelas Virtual dengan Google Classroom untuk Meningkatkan Hasil Belajar Kimia di SMA Negeri Bekasi. *Spin Jurnal Kimia & Pendidikan Kimia*, *2*(2), 177–190. https://doi.org/10.20414/spin.v2i2.2573

Danczak, S. M., Thompson, C. D., & Overton, T. L. (2017). "What Does the Term Critical Thinking Mean to You?" A Qualitative Analysis of Chemistry Undergraduate, Teaching Staff and Employers' Views of Critical Thinking. *Chemistry Education Research and Practice*, *18*(3), 420–434. https://doi.org/10.1039/c6rp00249h

Danurahman, J., & Arif, D. (2021). Kajian Kegunaan Google Classroom dalam Meningkatkan Kemampuan Berpikir Kritis Peserta Didik. *Edcomtech: Jurnal Kajian Teknologi Pendidikan*, *6*(2), 254–263. https://doi.org/10.17977/um039v6i12021p254

Dash, S. (2019). Google Classroom as a Learning Management System to Teach Biochemistry in a Medical School. *Biochemistry and Molecular Biology Education*, *47*(4), 404–407. https://doi.org/10.1002/bmb.21246

Eti, E. (2021). Implementasi Kelas Virtual dengan Google Classroom untuk Meningkatkan Hasil Belajar Kimia di SMA Negeri 1 Maumere. *Journal on Teacher Education*, *2*, 66–75.

Farihah, E. (2021). Teknik Portofolio dan Instrumen Asesmen dalam Pendidikan Anak Usia Dini. *Journal Fascho: Jurnal Penelitian dan Pendidikan Anak Usia Dini*, *1*(1), 32–44. Retrieved from https://www.ejournal.stitmuhngawi.ac.id/index.php/Fascho/article/view/22

Haddar, G. Al, Elfina, H., Kusumawati, I., Hairunisa, H., Sa'adah, U., Efendi, T. M. S., Efendi, R., Zulkarnaini, Z., & Hakim, A. R. (2023). *Metodologi Penelitian dalam Pendidikan*. Padang: Get Press Indonesia.

Hakim, R. I., Irwansyah, F. S., & Farida, I. (2020). The Making of E-Portfolios for Performance Assessment in Chemical Practicum. *Journal of Physics: Conference Series*, *1467*(1). https://doi.org/10.1088/1742-6596/1467/1/012031

Haruna, A., Ramlawati, R., & Auliah, A. (2018). Pengaruh Penggunaan Asesmen Portofolio pada Model Pembelajaran Kooperatif Tipe STAD terhadap Hasil Belajar Siswa Kelas X MIA SMA Negeri 1 Tellu Siattinge Kabupaten Bone (Studi pada Materi Pokok Struktur Atom dan Tabel Periodik). *Chemica: Jurnal Ilmiah Kimia dan Pendidikan Kimia*, *19*(1), 8. https://doi.org/10.35580/chemica.v19i1.6634

Hasan, S. W., Auliah, A., & Herawati, N. (2020). Pengembangan Instrumen Penilaian Kemampuan Berpikir Kritis Siswa SMA. *Chemistry Education Review (CER)*, *3*(2), 109. https://doi.org/10.26858/cer.v3i2.13315

Hidayat, K., Sapriya, S., Hasan, S. H., & Wiyanarti, E. (2022). Keterampilan Berpikir Kritis Peserta Didik dalam Pembelajaran Hybrid. *Jurnal Basicedu*, *6*(2), 1517–1528. https://doi.org/10.31004/basicedu.v6i2.2265

Ismail, D. M. I. (2020). *Asesmen dan Evaluasi Pembelajaran*. Makassar: Cendekia Publisher.

Juhanda, A., Wulan, A. R., & Fitriani, A. (2015).

Pengembangan Asesmen Portofolio Elektronik (Ape) dalam Menilai Sikap Ilmiah dan Penguasaan Konsep Siswa SMA pada Laporan Praktikum Pencemaran Lingkungan. *Prosiding Seminar Nasional Pendidikan Biologi 2015, Yang Diselenggarakan Oleh Prodi Pendidikan Biologi FKIP Universitas Muhammadiyah Malang*, *4*, 339–345.

Karyono, K. (2022). Penerapan Assesmen Portofolio untuk Meningkatkan Kemampuan Pemecahan Masalah dan Koneksi Matematis Siswa. *Didactical Mathematics*, *4*(1), 219–229. https://doi.org/10.31949/dm.v4i1.2402

Kasang, M. (2022). Meningkatkan Hasil Belajar IPA Materi Sistem Reproduksi Manusia melalui Penerapan Assesmen Portofolio terhadap Siswa Kelas IX-1. *JPPSD: Jurnal Pendidikan dan Pembelajaran Sekolah Dasar*, *1*(4), 315. https://doi.org/10.26858/pjppsd.v2i2.32747

Kriswantoro, K., Kartowagiran, B., & Rohaeti, E. (2021). A Critical Thinking Assessment Model Integrated with Science Process Skills on Chemistry for Senior High School. *European Journal of Educational Research*, *10*(1), 285–298. https://doi.org/10.12973/EU-JER.10.1.285

Kurniawan, A., Febrianti, A. N., Hardianti, T., Ichsan, Desy, Risan, R., Sari, D. M. M., Sitopu, J. W., Dewi, R. S., Sianipar, D., & Fitriyah, L. A. (2022). *Evaluasi Pembelajaran*. Padang: Global Eksekutif Teknologi.

Manik, A. C., Suryaningsih, S., & Muslim, B. (2020). Analisis Berpikir Kritis Kimia dalam Menyelesaikan Soal Two-Tier Berdasarkan Level Kemampuan Mahasiswa. *Jambura Journal of Educational Chemistry*, *2*(1), 28–39. https://doi.org/10.34312/jjec.v2i1.2999

Masluhah, M., & Afifah, K. R. (2022). Electronic Portofolio sebagai Instrumen Penilaian Pembelajaran Siswa di Era Digital. *Jurnal Basicedu*, *6*(2), 1883–1896. https://doi.org/10.31004/basicedu.v6i2.2236

Nahadi, N., & Firman, H. (2019). *Asesmen Pembelajaran Kimia*. Bandung: UPI PRESS.

Ni, L. B. (2020). Blended Learning through Google Classroom. *International Journal of Education and Pedagoical Sciences*, *14*(4), 1–23. Retrieved from https://publications.waset.org/10011150/blended-learning-through-google-classroom

Nurhayati, F., & Sumbawati, M. (2020). Pengembangan E-Portfolio sebagai Instrumen Penilaian Siswa Di SMK Negeri 2 Lamongan. *Jurnal Pendidikan Teknik Elektro*, *3*(1), 253–259.

Patimah, P., Aripin, I., & Gaffar, A. A. (2021). Penggunaan E-Learning Berbasis Google Classroom untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik. *Seminar Nasional Pendidikan FKIP UNMA*, 1–9.

Periadi, Y. S., Yahya, F., & Erfan, M. (2018). Pengembangan Evaluasi Berbasis Media E-Portofolio pada Pembelajaran IPA Materi Tekanan di Kelas VIII SMP Negeri 3 Lopok. *Quark: Jurnal Inovasi Pembelajaran Fisika dan Teknologi*, *1*(1), 46–50. https://doi.org/10.31227/osf.io/dwh5e

Permatasari, S., Zulhafizh, Z., Septyanti, E., Mustika, T. P., Rasdana, O., Pernantah, P. S., & Rizka, M. (2023). Asesmen Digital Berbasis Kahoot dalam Evaluasi Pembelajaran. *JIIP-Jurnal Ilmiah Ilmu Pendidikan*, *6*(4), 2710–2714. https://doi.org/10.54371/jiip.v6i4.1737

Rahayu, P., & Wulandari, I. A. (2021). Defining E-Portfolio Factor for Competency Certification Using Fuzzy Delphi Method. *Procedia Computer Science*, *197*(2021), 566–575. https://doi.org/10.1016/j.procs.2021.12.174

Rahmawati, Y., Agustin, M. A., Ridwan, A., Erdawati, E., Darwis, D., & Rafiuddin, R. (2019). The Development of Chemistry Students' 21 Century Skills through a STEAM Project on Electrolyte and Non-Electrolyte Solutions. *Journal of Physics: Conference Series*, *1402*(5). https://doi.org/10.1088/1742-6596/1402/5/055049

Rikizaputra, R., Lufri, L., Andromeda, A., & Mufit, F. (2021). Analisis Kemandirian Belajar dan Habits of Mind Siswa pada Pembelajaran Asesmen Portofolio. *Jurnal Penelitian Pendidikan IPA*, *7*(2), 232. https://doi.org/10.29303/jppipa.v7i2.630

Rosa, N. M., & Suryadi, A. (2022). Penggunaan Google Classroom pada Pembelajaran Kimia. *Jurnal Ilmiah Profesi Guru*, *3*(1), 1–8. https://doi.org/10.30738/jipg.vol3.no1.a11900

Sartika, A. Y. M., & Yusmaita, E. (2020). Pengembangan Asesmen Literasi Kimia pada Materi Hukum-Hukum Dasar Kimia dan Stoikiometri Kelas X SMA/MA. *Edukimia*, *2*(3), 128–133. https://doi.org/10.24036/ekj.v2.i3.a187

Sole, F. B., & Anggraeni, D. M. (2018). Inovasi Pembelajaran Elektronik dan Tantangan Guru Abad 21. *Jurnal Penelitian dan Pengkajian Ilmu Pendidikan: E-Saintika*, *2*(1), 10. https://doi.org/10.36312/e-saintika.v2i1.79

Song, B. K. (2021). E-Portfolio Implementation: Examining Learners' Perception of Usefulness, Self-Directed Learning Process and Value of Learning. *Australasian Journal of Educational Technology*, *37*(1), 68–81. https://doi.org/10.14742/ajet.6126

Stephenson, N. S., Miller, I. R., & Sadler-Mcknight, N. P. (2019). Impact of Peer-Led Team Learning and the Science Writing and Workshop Template on the

Critical Thinking Skills of First-Year Chemistry Students. *Journal of Chemical Education*, *96*(5), 841–849. https://doi.org/10.1021/acs.jchemed.8b00836

Sudarsana, I. K., Putra, I. B. M. A., Astawa, I. N. T., & Yogantara, I. W. L. (2019). The Use of Google Classroom in the Learning Process. *Journal of Physics: Conference Series*, *1175*(1). https://doi.org/10.1088/1742-6596/1175/1/012165

Sulistyawati, E. (2021). Penilaian Portofolio Based on Covid-19 Case dalam Perkuliahan Asesmen Pembelajaran Matematika sebagai Inovasi Asesmen Bermakna di Era New Normal. *ALGORITMA: Journal of Mathematics Education*, *3*(2), 101–115. https://doi.org/10.15408/ajme.v3i2.20621

Supriani, S., & Ubabuddin, U. (2023). Penilaian Keterampilan Portofolio dalam Pembelajaran di Sekolah. *Educational Journal: General and Specific Research*, *3*(3), 560–568.

Syam, S. (2020). Pengaruh Penggunaan Asesmen Portofolio pada Perkuliahan Perilaku Hewan terhadap Hasil Belajar Mahasiswa Pendidikan Biologi. *Jurnal Celebes Biodiversitas*, *3*(July), 1–6.

Syzdykova, Z., Koblandin, K., Mikhaylova, N., & Akinina, O. (2021). Assessment of E-Portfolio in Higher Education. *International Journal of Emerging Technologies in Learning*, *16*(2), 120–134. https://doi.org/10.3991/ijet.v16i02.18819

Wijayanti, A., & Basyar, M. A. K. (2016). The Development of Thematic-Integrated E-Portfolio Media Web Blog Based to Increase the Scientific Literacy of Elementary Teacher Education Program's Student. *Jurnal Pendidikan IPA Indonesia*, *5*(2), 284–290. https://doi.org/10.15294/jpii.v5i2.7684