Al-Ishlah: Jurnal Pendidikan
Vol.16, 2 (June, 2024), pp. 1839-1850
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v16i2.4744

The Implementation of Electronic Portfolio Assessment in Learning Chemistry through Google Classroom to Increase Students' Critical Thinking Skills

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ARTICLE INFO

Keywords:

electronic portfolio assessment;
google classroom;
critical thinking skills

Article history:

Received 2023-11-15
Revised 2024-03-08
Accepted 2024-05-20

ABSTRACT

Assessment is crucial in evaluating the success of learning and student competencies. Among the essential 21st-century skills is critical thinking. Furthermore, technological advancements necessitate the integration of digital media in education, including assessment processes. One such digital assessment method is the electronic portfolio assessment using Google Classroom. This study aimed to examine the implementation of electronic portfolio assessment via Google Classroom to enhance students' critical thinking skills. The research employed a literature review approach, drawing data from books and online journals. Data collection involved gathering information from several books and online journals pertinent to the research topic. Primary data sources included articles published in national and international journals from 2012 to 2023. Content analysis was used to analyze the data. The study's findings indicate that electronic portfolio assessment, coupled with feedback, can enhance students' critical thinking skills. Additionally, the features integrated into Google Classroom can further stimulate students' critical thinking during the learning process. Therefore, it can be concluded that electronic portfolio assessment through Google Classroom effectively enhances students' critical thinking skills.

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1. INTRODUCTION

Assessment is an important component in the chemistry learning process because it is useful for measuring the level of competency achievement of students (Hakim et al., 2020). Agustianti et al. (2022) states that the assessment process must be comprehensive. This means that the assessment includes the final results and processes that are carried out by students. One form of assessment that can assess students' abilities as a whole is a portfolio assessment (Pramana & Putra, 2019). Clarke & Boud (2018) also explained that portfolio assessment can describe student learning processes and outcomes. The

portfolio contains a collection of students' work which is properly and regularly documented (Herwani, 2022). This collection of evidence of work can be used to reflect on students' learning process and make it an effective tool for developing their thinking skills (Händel et al., 2020). Surapranata & Hatta (2006) also explained that feedback and self-assessment in portfolio assessment can help increase students' abilities. From this explanation, it can be concluded that portfolio assessment can be an alternative to increase students' abilities in classroom learning.

Portfolio assessment has several weaknesses, as explained by Juhanda et al. (2015). Portfolio assessment requires a lot of space in storing work, extra time in providing feedback, and cannot be carried out in a short and immediate manner. These problems can be overcome by using electronic portfolio assessment (Wijayanti & Basyar, 2016). An electronic portfolio assessment contains a selective and structured collection of digital evidence developed on the web (Pitts & Ruggirello, 2012). Electronic portfolio assessment is more flexible than conventional portfolios (Nurhayati & Sumbawati, 2020). In addition, electronic portfolios can reduce storage space, can use more varied format of assignments, can store for a long time and can provide assistance to students in collecting assignments (Masluhah & Afifah, 2022). Electronic portfolio assessments have advantages over conventional portfolio assessments, so it is possible that electronic portfolio assessments can be applied in classroom learning.

Electronic portfolio assessment in learning has been used by several previous researchers. The results of study conducted by Syzdykova et al. (2021) showed that the use of electronic portfolio assessment in learning can increase students' creativity, problem solving skills, and critical thinking skills. Research finding of Parwoto et al. (2019) stated that electronic portfolio assessment was better than conventional (non-electronic) portfolio assessment methods in measuring critical thinking skills. From the results of these studies, it can be concluded that electronic portfolio assessment can be used to measure critical thinking skills in classroom learning.

Electronic portfolio assessment is one of the uses of advances in information technology in education Learning Management System (LMS) (Hakim et al., 2020). One of the LMS applications that is currently the most widely used and easy for students to use is Google Classroom, a free web service developed by Google to simplify the creation, distribution and assessment of assignments in schools (Okmawati, 2020). Google Classroom application has many advantages, namely it can be used for free, has a large data storage, can be connected to other products from Google that can support the using Google Classroom, can be accessed anywhere and anytime and two-way communication can be established (Rohman, 2021). Furthermore, Andewi & Pujiastuti (2021), assert that using Google Classroom application has benefits, including that students can collect assignments easily and students can learn openly to convey ideas so as to stimulate students' critical thinking skills. Ni (2020) also explains the application of learning through Google Classroom can increase the ability of students in getting the information obtained. The results of research conducted by Bintarawati & Citriadin (2020) and Rosa & Suryadi (2022) show an increase in chemistry learning outcomes by using Google Classroom. It is described using Google Classroom can facilitate students in opening the material and assignments obtained from the teacher. In addition, students and teachers can discuss through the chat column feature on Google Classroom.

In the 21st century, education faces major challenges because it has to prepare students so that they do not get carried away by the rapid flow of misinformation. Critical thinking skills are part of higher order thinking skills, which are the main concern of education in the 21st century (Kriswantoro et al., 2021). Critical thinking is a skill that can be developed in learning certain disciplines (Danczak et al., 2017). In chemistry learning, critical thinking skills are used in data collection and analysis to arrive at conclusions, making critical thinking skills is a must for students (Stephenson et al., 2019). Chemistry learning has characteristics that contain concepts and calculations and has interrelationships between concepts, so students' critical thinking skills are needed.

So far, there is still limited research examining the use of Google Classroom as a means of electronic portfolio assessment in learning chemistry to increase critical thinking skills. Therefore, researchers feel the need to examine the strategy of electronic portfolio assessment in learning chemistry to increase

students' critical thinking skills. Research on the use of Google Classroom in learning chemistry has been carried out a lot (Rosa & Suryadi, 2022; Asari et al., 2022; Bintarawati & Citriadin, 2020) as a reference for advanced researchers in finding innovative research topics. Research question in this study include: 1) How is electronic portfolio assessment implemented in learning chemistry?; 2) How does Google Classroom implemented in learning chemistry?; 3) Can implementing electronic portfolio assessment through Google Classroom to increase critical thinking skills in learning chemistry?

2. METHODS

This research employed a library research method, which involves examining various literature sources related to the research problems (Roosinda et al., 2021). According to Zed (2008), the steps for conducting library research in this study included: 1) preparing necessary equipment; 2) taking notes on key source materials; 3) scheduling time for research; and 4) reading and recording research notes. A total of 10 journals were analyzed for this article. The inclusion criteria for the analyzed journals were that they discussed electronic portfolio assessments in chemistry learning, were indexed by Scopus or SINTA, and were open access. Data collection involved gathering information from several online books and journals related to the research problems, which were then analyzed to draw conclusions addressing the research questions and objectives. The obtained articles were analyzed based on specific criteria, including research objectives, methods, and results. The data were tabulated to facilitate analysis, and after thoroughly reading all parts of the articles, the researcher organized the data into tables. The final step was to provide an in-depth analysis based on the tabulated data.

3. FINDINGS AND DISCUSSION

3.1. Findings

The findings were obtained from the results of a review of articles. A summary of the research results of electronic portfolio assessment and the use of *Google Classroom* in chemistry learning is presented in Table 1 and Table 2.

Table 1. Research Results from Electronic Portfolio Assessment in Learning Chemistry

No.	Writer; Publication Year	Title	Review Results
1	Nahadi et al. (2023),	Development of an Electronic Portfolio-Based Assessment Strategy to Improve Students' Habits of Thinking in Buffer Solution Material	The purpose of this study was to develop an electronic portfolio-based assessment strategy to improve students' thinking habits on buffer solution material. This study uses the 4D Research and Development model. The tasks developed in this electronic portfolio assessment consisted of three tasks, namely component concept maps and working principles of buffer solutions, practical reports on the preparation of buffer solutions, and posters on the role of buffer solutions. Based on the results of limited trials, the developed electronic portfolio-based assessment strategy can improve students' thinking habits on buffer solution material.
2	Hakim et al. (2020)	Making E-Portfolio for Performance Assessment in Chemistry Practicum	The aim of this research is to develop a digital tool to enhance the assessment of chemistry practicums in line with advancements in information technology. The developed e-

No.	Writer; Publication Year	Title	Review Results
			portfolio is designed to evaluate the planning, execution, and reporting aspects of digital-based chemistry practicums. Validation results indicate that the e-portfolio is highly valid, with an average validation score of 0.85. Limited trial results further demonstrate the product's suitability for use, with an average approval rating of 86.87%.
3	Nahadi et al. (2021)	Development of an Electronic Portfolio Assessment Model in Chemistry Learning to Develop the Habits of Thinking and Reasoning in Indonesian Students	The aim of this research is to create an electronic portfolio assessment model for chemistry education, intended to foster students' thinking and reasoning habits. The study employs a Research and Development approach, producing a test and non-test assessment instrument package. This package includes three main indicators of thinking habits and five indicators of reasoning within chemistry learning. The findings indicate that the developed items are both valid and reliable. Additionally, the designed electronic portfolio assessment model demonstrates a satisfactory level of practicality.
4	Ramlawati et al. (2014)	The Effect of the Electronic Portfolio Assessment Model on Increasing Students' Generic Science Skills in Inorganic Chemistry Practicum	This study aimed to evaluate the impact of implementing the Electronic Portfolio Assessment model on enhancing students' generic science skills during inorganic chemistry practicums. The research employed a Pretest-Posttest Control Group design. Findings revealed that students assessed using the Electronic Portfolio Assessment model showed significant improvement in their generic science skills.
5	(Ramlawati et al., 2012)	Development of an Electronic Portfolio Assessment (APE) Model to Improve Students' Generic Science Skills	The objective of this research is to create an electronic portfolio assessment model for inorganic chemistry practicums. The study employs the Embedded Experimental design. The findings indicate that the APE model enhances the skills of all students. According to student questionnaires, the APE model improves self-assessment, conceptual understanding, IT proficiency, attention, engagement, and motivation.

Table 2. Research Results from Use *Google Classroom* in Learning Chemistry

No.	Writer; Publication Year	Title	Review Results
1	Rosa & Suryadi (2022)	Usage Google Classroom in Chemistry Learning	This study aims to describe the impact of Google Classroom on chemistry learning. The research employs a descriptive design using a One Shot Case Study approach. The findings indicate a significant positive effect on student learning outcomes following the implementation of Google Classroom.

No.	Writer; Publication Year	Title	Review Results
2	Asari et al. (2022)	Utilization Relations Google Classroom on Chemistry Learning Outcomes at SMA Negeri 1 Minas	This study aims to determine the relationship between the use of Google Classroom and chemistry learning outcomes at SMA Negeri 1 Minas. The research employs a correlation method. The correlation test results show a Pearson correlation value of 0.454. The positive Pearson correlation value indicates that increased utilization of Google Classroom is associated with improved student learning outcomes.
3	Bintarawati & Citriadin (2020)	Virtual Class Implementation with Google Classroom to Improve Chemistry Learning Outcomes at Bekasi State Senior High School	The aim of this research is to evaluate the outcomes of chemistry learning. The study employs a classroom action research method. The findings and data analysis indicate that implementing virtual classes through Google Classroom can enhance both student engagement and chemistry learning outcomes.
4	Mulatsih (2020)	Application of Google Classroom, Google Form, and Quizizz in Chemistry Learning in the Time of the COVID-19 Pandemic	This study aims to describe the implementation of online chemistry learning activities, the execution of online chemistry knowledge assessments, and to evaluate the effectiveness of these online learning activities in class XI MIPA at SMAN 1 Banguntapan. The findings indicate that using Google Classroom for online chemistry learning in this class is quite effective.
5	Eliyarti et al. (2020)	Contributions Overview Google Classroom in Supporting Basic Chemistry Lectures	The aim of this research is to explore students' perspectives on online basic chemistry learning through Google Classroom. This study employed a descriptive qualitative approach. The results reveal that, among 70 participants, 80% found Google Classroom to be user-friendly, while 20% did not. Additionally, 64.28% agreed that Google Classroom facilitated task completion, whereas 35.71% disagreed. Overall, the use of Google Classroom in basic chemistry education received a positive response from students.

3.2. Discussion

Portfolio Assessment in Learning Chemistry

Assessment is an activity to obtain information about students where the information is used to determine the progress and development of student learning (Wijayanto et al., 2023). Assessment is an integrated part of the learning process (Sari & Mauliza, 2020). According to its function, assessment can be divided into assessment as a learning, assessment for learning, and assessment of learning (Sigalingging, 2022). So far, the implementation of assessments has tended to focus on assessment of

learning, for example a summative assessment (Arif et al., 2022). This results in students not being able to carry out sel self-assessments. Even though self-assessment is needed by students to find out their strengths and weaknesses, so efforts are needed to overcome this problem. According to Triwiyono (2018), the only effort that can be made to solve this problem is by implementing assessment for learning.

Assessment for learning is an assessment that is carried out during the learning process and is used as a reference in making improvements to learning (Sutama et al., 2021). There is implementation assessment for learning can be used by educators to assess the potential of students and to measure how capable students are in participating in learning (Mangal & Mangal, 2019). On assessment for learning, educators also provide feedback to students so that it can be used to improve student performance (Hamid, 2019). Feedback is a form of response to students' work and is used to achieve learning objectives (Sinambela et al., 2022). This feedback from the teacher turns out to have an impact on students in learning. According to research results of Dini & Muchlis (2022), there is feedback in based learning assessment for learning can improve student learning outcomes. One form of assessment that applies feedback to students' work is portfolio assessment (Ismail, 2020).

A portfolio is a collection of students' work which is collected in a systematic and organized manner as a result of learning efforts over a certain period (Ismail, 2020). Meanwhile, portfolio assessment is an assessment that is carried out continuously to find out the development and abilities of students through their portfolios, so that the work can be assessed and given feedback by the teacher within a certain period (Tiastra, 2022). The collection of works in the portfolio is used by students to reflect so that students are able to find out the weaknesses and strengths of their work and will be used as further learning material (Supriyadi, 2020). There is feedback and self-assessment, making portfolio assessment an alternative in improving students' abilities (Surapranata & Hatta, 2006).

Portfolio assessment is an example of class-based assessment that can be used to determine the level of achievement and development of students based on work results from time to time (Nahadi et al., 2021). Portfolios are not only a collection of student work, but also a source of information for educators and students (Sani, 2016). According to Bundu (2017), portfolios provide an accurate picture of the achievement of student learning outcomes and which materials require attention. Furthermore, the results of the assessment can be used by educators to improve the learning process that has been carried out(Sumardi, 2020).

Portfolio assessment cannot be separated from the learning process (Hamid, 2019). In chemistry learning, portfolio assessment is an effort to obtain various information on a regular, continuous and comprehensive basis regarding the process and development of students in learning chemistry (Nahadi & Firman, 2019). However, conventional portfolio assessment has several weaknesses. According to Juhanda et al. (2015), some of the weaknesses of conventional portfolio assessment such as requiring a place for storage, extra time in providing feedback, and cannot be carried out in a short time and immediately. These problems can be overcome by electronic portfolio assessment(Wijayanti & Basyar, 2016).

Thus, portfolio assessment becomes a form of assessment that can be implemented in learning chemistry. Feedback in learning is useful for students' learning progress. The feedback given by the teacher can be a reflection for students to carry out self-assessment and continue to overcome weaknesses so that this will increase critical thinking skills.

Electronic Portfolio Assessment in Learning Chemistry

An electronic portfolio is defined as a compilation of portfolio items stored in electronic formats such as audio-visual, graphics or text (Kurniawan et al., 2022). According to Masluhah & Afifah (2022),

electronic portfolios are student documents that contain information about student competencies made in various forms of digital media. Wibowo (2023) describes electronic portfolio assessment as a method that allows students to store and create portfolios containing tasks that have been completed in a digital environment. From these several definitions it can be concluded that electronic portfolios are student files containing assignments that have been completed and stored in digital media.

Faulkner & Allan (2009) explains the benefits of using electronic portfolios, including: 1) to increase student participation and retention; 2) to develop students' reflective skills; 3) provide opportunities to change learning values into values in learning; 4) to make teaching and learning activities using a holistic approach; 5) to offer assistance in disciplining students; and 6) to offer the potential of students. In addition, electronic portfolios can reduce the area for storing assignments by using various formats, can be stored for a long time and can provide assistance to students in collecting assignments(Masluhah & Afifah, 2022). There are several advantages to electronic portfolio assessment compared to conventional portfolio assessment (Nurhayati & Sumbawati, 2020), including: 1) electronic portfolios can accommodate an increased range of assessments and are more flexible; 2) electronic portfolios are easily published; 3) the electronic portfolio is a basis that can be used to link the entire curriculum; 4) electronic portfolio allows discussion with a number of parties; 5) electronic portfolios can improve the practice of reflective and independent skills.

Electronic portfolio assessment can be implemented in various subjects in schools (Lasminiar, 2022). Through the use of electronic portfolio assessment in learning, students can develop their skills and potential because the assessment given by the teacher is not only centered on evaluating results but on the work in the learning process (Masluhah & Afifah, 2022). With the use of electronic portfolio assessment, teachers can provide feedback and students can reflect on their learning. The existence of this process can foster students' critical thinking (Kurniawan et al., 2022). Electronic portfolio assessment is also seen as being able to revolutionize and modernize the way students learn using the available platforms (Artasari, 2021).

From this description of electronic portfolio assessment, it can be concluded that electronic portfolio assessment can overcome the weaknesses of conventional portfolio assessment. Electronic portfolio assessment is very likely to be applied in learning chemistry. Through electronic portfolio assessment, providing feedback from teachers to students will be easier because it can be done anywhere and any time via digital media. The reflection process carried out by students as a result of this feedback will grow students' thinking skills.

Using Google Classroom in Learning Chemistry

Many applications are used in conducting online learning. One of which is Google Classroom which is currently widely used in educational institutions such as schools. Google Classroom is a web service developed by Google free of charge for schools with the aim of simplifying, creating, distributing and assessing assignments without face-to-face meetings (Indarwati, 2021). Use Google Classroom making teaching and learning activities more productive and meaningful by simplifying tasks, increasing collaboration, and fostering communication (Atikah et al., 2021). Teachers can create classes, give assignments, give feedback, and see everything in one place.

Google Classroom is designed to facilitate the interaction of teachers and students in cyberspace (Bintarawati & Citriadin, 2020). Jamaludin et al. (2022) also explained that Google Classroom provides a number of features that can facilitate the online learning process. Broadly speaking, the features available in Google Classroom (Harjanto & Sumarni, 2019), namely: flow, class assignments, and people. (1) Flow (Stream): this feature is the page where teachers post and make announcements. (2) Class assignments: this feature allows teachers to set assignments. In this feature the teacher can create

questions, quizzes, assignments, and post material for students. (3) People: this feature the teacher can see a list of teachers and students enrolled in the class.

Benefits of using Google Classroom in learning, namely: 1) Google Classroom has a feature for sharing assignment schedules so that students, apart from knowing the information on the assignments given, can also find out when there are assignments and when to send the results; 2) Google Classroom facilitating the submission of assignments in digital formats; 3) Google Classroom allows students to quickly read the material distributed by the teacher before class begins; 4) students can keep up with class if they cannot attend class. In addition, there are several benefits of Google Classroom among others: 1) can be run on all devices (cellphone or android, tablet or pc) very easily; 2) can be integrated with other Google products; 3) students can communicate with each other and work collaboratively; 4) can collect tasks very easily and quickly; 5) reduce paper use (Evans, 2020).

The features that Google Classroom has certainly make it very easy for teachers to provide teaching materials, assignments and carry out online learning. As for students, it can make it easier to access teaching materials and collect assignments given by teacher. Apart from that, teachers and students can discussions through the comments feature. This is certainly very supportive if Google Classroom is applied in learning chemistry.

Linkage of Electronic Portfolio Assessment Using Google Classroom in Learning Chemistry with Critical Thinking Skills

A person's skills in analyzing an idea logically and systematically to make and evaluate in making decisions so that they are successful in solving the problems they face are interpreted as critical thinking skills (Fitria & Indra, 2020). Ennis (1996) defines critical thinking skills as skills in expressing goals accompanied by firm reasons regarding what is believed and done. From these several definitions it can be concluded that critical thinking skills are skills in analysing, evaluating and solving problems accompanied by logical and systematic reasons related to what is believed and done. Critical thinking skills can be measured using instruments intended to measure critical thinking skills by oriented to the aspects in them (Rosyana et al., 2019).

Critical thinking skills in chemistry learning are needed to analyze the symptoms and phenomena that appear (Manik et al., 2020). Chemical material that has the characteristics of arithmetic and contains concepts and interrelationships between concepts and familiarizes students to think critically. Critical thinking skills can not only be developed through learning, but can be developed and improved through assessments that reflect critical thinking (Hasan et al., 2020).

Electronic portfolio assessment in learning has been used by several previous researchers. The results of study conducted by Syzdykova et al. (2021), concluded that the use of electronic portfolios can improve critical thinking skills. Research Parwoto et al. (2019) found that in measuring critical thinking skills by applying electronic portfolio assessments better than non-electronic electronic portfolio assessments. From the results of this research, it can be concluded that electronic portfolio assessment can increase critical thinking skills.

Electronic portfolio assessment has advantages over conventional portfolio assessment. The advantage of electronic portfolio assessment is that teachers can provide immediate feedback to students. Thus students can immediately carry out self-assessments which in turn can increase their competence (Ramlawati et al., 2012). According to Kurniawan et al. (2022), the existence of this process can foster students' critical thinking. After receiving feedback from the teacher, students can reupload the assignments that have been corrected. This activity can be done through the features available on Google Classroom. Google Classroom can assist teachers and students in carrying out a more in-depth learning process because students and teachers can collect assignments, distribute assignments, assess assignments anywhere and anytime (Bintarawati & Citriadin, 2020). Features inside Google Classroom designed according to learning objectives that include cognitive aspects, one of which is critical thinking skills. Submission of material through features Google Classroom can help students construct knowledge, accompanied by awareness of students to do the job well. This can add insight into digital

literacy so as to enable students to process critical thinking better and continuously (Patimah et al., 2021).

Furthermore, the use of electronic portfolios is very important because it provides an opportunity to introduce alternative assessments that are appropriate for the digital era (Artasari, 2021). Steps in the use of electronic portfolio assessmen through Google Classroom to increase critical thinking skills are described as follow: The teacher ensures all students enter Classroom, then teacher starts giving the assignment independently by pressing add and clicking for the assignment. The teacher sets the deadline for collecting assignments. Students can see each assignment given by the teacher. Teachers can also quickly see who has turned in assignments. The teacher provides comments (feedback) through the comments feature of the work that has been collected by students. Students can improve the assignments made according to the comments that have been given by the teacher. The teacher gives the value of the final results of the students' assignments after fixing the assignment.

Utilization Google Classroom in electronic portfolio assessment is expected to facilitate the learning process so that educators can interact with students. Using this application also provides an opportunity for students to become familiar with technology. In addition, there is a gift feedback from educators through the features they have Google Classroom. It is also expected to improve students' critical thinking skills in chemistry learning.

4. CONCLUSION

Based on the preceding discussion, it can be concluded that Google Classroom is a viable platform for conducting electronic portfolio assessments in chemistry education. The accessibility of Google Classroom facilitates online learning for both teachers and students, enhancing their ability to interact seamlessly. The platform's commenting feature allows teachers to provide timely feedback on student submissions, enabling students to make iterative improvements. This continuous feedback loop fosters the development of students' critical thinking skills. Therefore, implementing electronic portfolio assessments via Google Classroom can significantly enhance critical thinking in chemistry students. While numerous studies have explored electronic portfolio assessments and the use of Google Classroom in chemistry education, there is a dearth of research specifically focused on the integration of these two elements. Future research could address this gap by examining different variables in this context. The findings presented in this journal can serve as a valuable reference for the application of electronic portfolio assessments in online chemistry learning, particularly in fostering critical thinking skills.

Acknowledgments: Thank you to all parties who played a role in providing smoothness and convenience in writing articles regarding the Electronic Portfolio Assessment using *Google Classroom* in Learning Chemistry to Improve Critical Thinking Skills. Hopefully this article can be useful for teachers and all *stakeholder* education in improving the quality of learning, especially in learning chemistry.

Conflicts of Interest: No conflict of interest

REFERENCES

Agustianti, R., Abyadati, S., Nussifera, L., Irvani, A. I., Handayani, D. Y., Hamdani, D., & Amarulloh, R. R. (2022). *Asessmen dan Evaluasi Pembelajaran*. Tohar Media.

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

Arif, A. M., Hiljati, Sayekti, S. P., Resi, B. B. F., Muliani, N. M., Kharismawati, I., Ahyar, D. B., Wardhana, A., Lusiani, Rismaningsih, F., & Ersani, E. (2022). *Strategi Pembelajaran*. Penerbit Media Sains Indonesia.

Artasari, Y. (2021). *Antologi Artikel Ilmiah*. Nilacakra.

Asari, D., Zakir, S., Sesmiarni, Z., & Melani, M. (2022). Hubungan Pemanfaatan Google Classroom

terhadap Hasil Belajar Kimia di SMA Negeri 1 Minas. *HUMANTESCH: Jurnal Ilmiah Multidisiplin Indonesia*, *2*, 176–182.

Atikah, R.-, Prihatin, R. T., Hernayati, H., & Misbah, J. (2021). Pemanfaatan Google Classroom Sebagai Media Pembelajaran Di Masa Pandemi Covid-19. *Jurnal Petik*, *7*(1), 7–18. https://doi.org/10.31980/jpetik.v7i1.988

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

Bundu, P. (2017). *Asesmen Autentik dalam Pembelajaran*. Cendekia Publisher.

Clarke, J. L., & Boud, D. (2018). Refocusing portfolio assessment: Curating for feedback and portrayal. *Innovations in Education and Teaching International*, *55*(4), 479–486. https://doi.org/10.1080/14703297.2016.1250664

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

Dini, P. C., & Muchlis, M. (2022). Peningkatan Hasil Belajar Peserta Didik melalui Implementasi Pembelajaran Berbasis Assessment for Learning pada Materi Kesetimbangan Kimia. *PENDIPA Journal of Science Education*, *6*(2), 565–572. https://doi.org/10.33369/pendipa.6.2.565-572

Eliyarti, Rahayu, C., & Zakirman. (2020). Tinjauan Kontribusi Google Classroom dalam Mendukung Perkuliahan Kimia Dasar. *Jurnal Pendidikan Kimia Indonesia*, *4*, 32–39.

Ennis, R. H. (1996). *Critical Thinking*. Prentice-Hall.

Evans, Z. (2020). *Google Classroom: The Ultimate 2020 User Guide For Teachers To Know How To Use Effectively Google Classroom, Improve The Quality Of Lesson and Boost Student Engagement*. Independently published.

Faulkner, M. E., & Allan, G. (2009). Building Communities of Practice for E-Portfolio Implementation: An Initial Approach by Two Australian Institutions. *International Journal of Learning in Social Contexts*, *2*, 31–54.

Fitria, Y., & Indra, W. (2020). *Pengembangan Model Pembelajaran PBL Berbasis Digital untuk Meningkatkan Karakter Peduli Lingkungan dan Literasi Sains*. Deepublish.

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

Hamid, A. (2019). *Penyusunan Tes Tertulis (Paper and Pencil Test)*. Uwais Inspirasi Indonesia.

Händel, M., Wimmer, B., & Ziegler, A. (2020). E-portfolio use and its effects on exam performance–a field study. *Studies in Higher Education*, *45*(2), 258–270. https://doi.org/10.1080/03075079.2018.1510388

Harjanto, A. S., & Sumarni, S. (2019). Teachers' experiences on the use of Google Classroom. *3rd English Language and Literature International Conference (ELLiC) Proceedings*, *3*, 172–178.

Hasan, sri 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

Herwani. (2022). Penilaian Keterampilan Portofolio dalam Pembelajaran di Sekolah. *Crosss-Border*, *5*(1), 12–25.

Indarwati, S. (2021). Efektivitas Penggunaan Google Classroom dalam Pembelajaran Jarak Jauh Mata Pelajaran PAI dan Budi Pekerti di Masa Pandemi COVID-19. *EDUCATOR: Jurnal Inovasi Tenaga Pendidik Dan Kependidikan*, *1*, 1–8.

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

Ismail, I. (2020). *Asesmen dan Evaluasi Pembelajaran*. Cendekia Publisher.

Jamaludin, J., Yuswardi, Y., Muttaqin, M., Mahmudi, A. A., Arni, S., Tantriawan, H., Ekowicaksono, I.,

Yulita, W., Iqbal, A., Sirait, H., Romindo, R., Resha, M., Sasongko, D., Ridho, F., & Simarmata, J. (2022). *Google Workspace for Education Platform Pendidikan Digital: Konsep dan Praktik*. Yayasan Kita Menulis.

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.

Kriswantoro, 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*. Global Eksekutif Teknologi.

Lasminiar, P. (2022). A Teacher's Experiences on the Use of E-Portfolio as Students' Portfolio Assessment in Teaching Speaking: A Narrative Inquiry. *Jurnal Basicedu*, *5*(5), 3829–3840.

Mangal, S. K., & Mangal, S. (2019). *Assessment for Learning*. PHI Learning Private Limited.

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

Mike Okmawati. (2020). the Use of Google Classroom During Pandemic. *Journal of English Language Teaching*, *9*(2), 438–443.

Mulatsih, B. (2020). Penerapan Aplikasi Google Classroom, Google Form, dan Quizizz dalam Pembelajaran Kimia di Masa Pandemi Covid-19. *Ideguru: Jurnal Karya Ilmiah Guru*, *5*(1), 16–26.

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

Nahadi, Purnawarman, P., & Siswaningsih, W. (2021). Development of an Electronic Portfolio Assessment Model in Learning Chemistry to Develop the Habits of Mind and Reasoning of Indonesian Students. *Journal of Physics: Conference Series*, *1788*(1). https://doi.org/10.1088/1742-6596/1788/1/012034

Nahadi, Siswaningsih, W., Apriani, D. D., Daniati, D., Purnawarman, P., & Lestari, T. (2023). *DEVELOPMENT OF AN ELECTRONIC PORTFOLIO- BASED ASSESSMENT STRATEGY TO IMPROVE STUDENT ' S HABITS OF MIND IN BUFFER SOLUTION MATERIAL*. *18*(3), 1401–1412.

Ni, L. B. (2020). *Blened Learning Through Google Classroom*. *14*(4), 1–23.

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

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.

Parwoto, P., Rusmayadi, R., & Bachtiar, M. Y. (2019). Pengaruh Assesmen Portofolio Berbasis E-Learning Dan Minat Baca Terhadap Kemampuan Berpikir Kritis Mahasiswa PGPAUD FIP UNM. *Seminar Nasional LP2M …*, 502–506. https://ojs.unm.ac.id/semnaslemlit/article/view/11534

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.

Pitts, W., & Ruggirello, R. (2012). Using the e-Portfolio to document and evaluate growth in reflective practice : The development and application of a conceptual framework. *International Journal of EPortfolio*, *2*(1), 49–74.

Pramana, K. A. B., & Putra, D. B. K. N. S. (2019). *Merancang Penilaian Autentik*. CV Media Educations.

Ramlawati, Liliasari, & Wulan, A. R. (2012). Pengembangan Model Assesmen Portofolio Elektronik (

APE) untuk Meningkatkan Keterampilan Generik Sains Mahasiswa Development of Electronic Portfolio Assessment (EPA) Model to Improve Student ' s Generic Science Skills merupakan mata kuliah wajib pada K. *Jurnal Chemica*, 31–41.

Ramlawati, R., Liliasari, L., Martoprawiro, M. A., & Wulan, A. R. (2014). The Effect of Electronic Portfolio Assessment Model to Increase of Students' Generic Science Skills in Practical Inorganic Chemistry. *Journal of Education and Learning (EduLearn)*, *8*(3), 179–186. https://doi.org/10.11591/edulearn.v8i3.260

Rohman, A. (2021). *Panduan Praktis Pembelajaran Daring dengan Google Classroom dan Google Meet*. PT Elex Media Komputindo.

Roosinda, F. W., Lestari, N. S., Utama, A. A. G. S., Anisah, H. U., Siahaan, A. L. S., Islamiati, S. H. D., Astiti, K. A., Hikmah, N., & Fasa, M. I. (2021). *Metode Penelitian Kualitatif*. Zahir Publishing.

Rosyana, W., Ashadi, A., & Mulyani, S. (2019). PENGEMBANGAN INSTRUMEN PENILAIAN THREE-TIER MULTIPLE CHOICE (Three- TMC) UNTUK MENGUKUR KETERAMPILAN BERPIKIR KRITIS SISWA PADA MATERI KIMIA LARUTAN PENYANGGA KELAS XI SMA. *INKUIRI: Jurnal Pendidikan IPA*, *8*(1), 48. https://doi.org/10.20961/inkuiri.v8i1.31814

Sani, R. A. (2016). *Penilaian Autentik*. PT Bumi Aksara.

Sari, R. P., & Mauliza. (2020). *Panduan Penilaian Kinerja Praktikum Kimia*. Penerbit Lakeisha.

Sigalingging, R. (2022). *Guru Penggerak dalam Paradigma Pembelajaran Kurikulum Merdeka*. Tata Akbar.

Sinambela, P. N. J. M., Bulan, A., Febrina, A., Susilowaty, N., Fatchurrohman, M., Novianti, W., Sembiring, E. T. B., Chairunnisa, Subroto, D. E., & Mardhiyana, D. (2022). *Model-Model Pembelajaran*. Sada Kurnia Pustaka.

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

Sumardi. (2020). *Teknik Pengukuran dan Penilaian Hasil Belajar*. Deepublish.

Supriyadi. (2020). *Evaluasi Pendidikan*. Penerbit NEM.

Surapranata, S., & Hatta, M. (2006). *Penilaian Berbasis Kelas: Penilaian Portofolio, Implementasi Kurikulum 2004*. PT Remaja Rosdakarya.

Sutama, Fuadi, D., Hadifa, S. H. N., & Novitasari, M. (2021). *Pembelajaran Matematika Kolaboratif*. Muhammadiyah University Press.

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

Tiastra, M. (2022). *Model Pembelajaran Inkuiri Terbimbing Berbasis Asesmen Portofolio dalam Pembelajaran Kimia di SMA*. CV Bintang Semesta Media.

Triwiyono, E. (2018). Pengembangan Assessment for Learning Dalam Praktik Pemesinan Di Smk Sesuai Kurikulum 2013. *Taman Vokasi*, *2*(2), 144. https://doi.org/10.30738/jtvok.v5i2.2472

Wibowo, H. S. (2023). *Pengembangan Teknologi Media Pembelajaran: Merancang Pengalaman Pembelajaran yang Inovatif dan Efektif*. Tiram Media.

Wijayanti, A., & Basyar, M. A. K. (2016). The development of thematic-integrated E-portfolio me-dia 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

Wijayanto, P. W., Sulistyowati, N. W., Manopo, Y., Lestari, Z. W., Sembiring, L. T. A. B., Suwarno, & Nanang. (2023). *Assesment Hots*. PT Global Eksekutif Teknologi.

Zed, M. (2008). *Metode Penelitian Kepustakaan*. Yayasan Obor.