

The impact of Google Classroom to increase students' information literacy

Citra Ayu Dewi¹, Muhali Muhali¹, Yeti Kurniasih¹, Diah Lukitasari², Abdul Sakban³

¹Department of Chemistry Education, Universitas Pendidikan Mandalika, Mataram, Indonesia

²Department of Psychology Education, Universitas Pendidikan Mandalika, Mataram, Indonesia

³Department of Social Education, Universitas Muhammadiyah Mataram, Mataram, Indonesia

Article Info

Article history:

Received Jun 2, 2021

Revised Apr 6, 2022

Accepted May 9, 2022

Keywords:

Google Classroom

Information literacy

Online learning

Students' attitude

ABSTRACT

Information literacy at the higher education level is very important because it tends to be problematic in fostering students' critical thinking skills, including awareness, collection, understanding, analysis, synthesis, and the use of information and their attitudes to the treatment of information at the university level. This study examined the effects of the online learning Google Classroom in enhancing information literacy among students. This study observed a one-group pretest-posttest experimental design. This research involved 65 students from the Chemistry Course under the Biochemistry Program. The instrument used to assess students' information literacy consist of fair set of multiple-choice questions. The test was found to be very valid at 4.22% and highly reliable at an alpha level of 0.86. The findings of this research showed that the information literacy of students improved before and after their learning exposure using Google Classroom based on the descriptive and inferential statistics. Moreover, the students' attitude towards the online platform shows that they are more willing to learn using Google Classroom than the non-online or conventional learning platforms. Therefore, applying Google Classroom in online learning is effectively boost students' information literacy.

This is an open access article under the [CC BY-SA](#) license.



Corresponding Author:

Citra Ayu Dewi

Department of Chemistry Education, Universitas Pendidikan Mandalika

Jln. Pemuda No. 59A Mataram, West Nusa Tenggara, Indonesia

Email: ayudewi_citra@ikipmataram.ac.id

1. INTRODUCTION

In the 21st century, digital technologies and communication instruments are emerging in school education. Students must have the ability to access, compile, and gather useful knowledge from various digital sources for this learning pattern, determine the adequacy and reliability of data collected, and evaluate whether selected information can be processed [1], [2]. So, in the 21st-century, students need information literacy to make learning progress effective.

Info-literacy (IL) refers to know-how and effective methods of information management to understand the logic behind information gathering, synthesizing, analyzing, interpreting, and assessing the relevant information [3]–[5]. IL addresses capability in four main points of view [1], [2]: i) A cognitive view on knowledge literacy for educating and solving problems; ii) A meta-cognitive view of information processing capabilities; iii) An important perspective on study appreciation and enjoyment; iv) A socio-cultural perspective on the ability to display autonomy and social responses. The study of information literacy during this period has gained increasing interest, especially in university education. White [6] stressed that knowledge literacy enhances the abilities of students to think critically. Meanwhile, information

literacy showed to be linked to student motivation and confidence in knowledge searching the internet [7]. However, Meulemeester *et al.* [8] stressed how the higher education curriculum adds critical knowledge literacy. Novo and Bastos [9] stated that at university level the concept of literacy of knowledge remains problematic. It is less well known the importance of information literacy.

Schools and education systems should integrate technologically rich learning platforms and tools to understand the potential benefits of the changing emerging technologies and the interactive learning climate [10]. Information and communication technology (ICT) entry was regarded as positive regarding students' self-reported digital skills [11]. In contrast, Zhong found a negative link between the rate of ICT integration in different countries and the digital skills of young people. This result shows that an increase in the rate of ICT penetration without schools, in particular digital skills, does not enable young people to learn ICT in education. In addition, as technology is continuously evolving and complex, students need to continually develop their knowledge and skills [12]. In reality, high-performance workplaces use modern technology to increase productivity quickly. This development has contributed to fundamental changes in literature and the quality of organizational effectiveness [13], [14].

Today, higher learners are rapidly embedded in digital technology, allowing them to use these technologies and develop new technologies, scientists, and web designers. A lot of students want new technologies and benefit from them [15]. However, new technology continues to change students' lives [16]. This makes an online forum a way to save time, develop networking skills and educate people and enable people to keep up-to-date [12]. Margaryan *et al.* [17] declared that millennials could not respond to modern technologies in the classroom. The implementation process thus affects their behavior target and the achievement of the learning process directly [18]. Learning management systems (LMS) is one of the most troubling higher education devices [19] such as Moodle, Blackboard, Edmodo, Sakai, and Google Classroom are LMS. Google Classroom recently increased its prominence, value, and the most rapidly adopted form of university education [20]. It is internet-free software that can be used to create and manage online courses for people with a Google account.

Google Classroom is one of the best online learning tools because it is innovative. The education group accepted a proposal from Google Classroom for the e-learning method. Technology is incorporated into classrooms. The widespread use of this revolutionary technology generated literature data. Teachers can support face-to-face learning through Google Classroom [21]. Google Classroom provides fresh and varied challenges in continuing education to teachers and students. First, everybody worldwide has a package called Google education apps tools and applications (such as Gmail and Google Drive) [22]. Second, Google Classroom usability is renowned [23] and its easy organization of work and time saving, fast access from tablet, personal computer, and cellular devices. According to estimates, Google Classroom got almost 30 million teaching and students' jobs in the first six months. The educational group, therefore, recommends Google Classroom strongly [22]. Finally, we offer the flexibility of Google Classroom in the programming process online, minimize travel costs and meet all the users. Google Classroom, a Google education program, will provide online education [24]. Google Classroom are highly recommended as they can be used anywhere and anytime via a smartphone. The students do not know about smartphones. Most of them already have Google teachings to do effective and creative learning [25].

Further study was also suggested to explore how these systems affect student training and equate user patterns with the actual goal of the system such that they are successful students. In using these technologies, the method must be evaluated in a given situation to genuinely and under no circumstances determine its effectiveness [26]. The main assumption is that technical advantages of hypocritical higher education cannot enhance learning by applying technology to traditional training [27]. Previous researchers [17], [28] also noted that even with a boom in educational technology capital, inadequate engagement and adaptation persist in the classroom. Students' initial acceptability and sensory inclinations to incorporate these emerging technologies into educational processes are partially the results. Consequently, students' use of such facilities is still limited, and it is important to resolve the reasons behind these habits. According to Jakkaew and Hemrungrrote [20], further research into user engagement and comfort is needed while identifying methods for enhancing learning. Furthermore, if these instruments do not take responsibility, any technology used in the classes will not work, and revenues will drop well [29]. The location of Google Classroom mobile teaching. Bain *et al.* [30] recorded the acceptance and conduct of classes by Google in universities since the usage of literature by Google Classroom is reduced worldwide.

To find solutions to existing problems based on the concept above, an invention is necessary. Researchers used learning tools through online learning models at Google Classroom to solve those problems. This model also allows students to carry out experiments/study. Teachers must be careful not to supply the contents, since teachers will deliver them electronically via Google Classroom outside the classroom. During face-to-face class, the teacher will provide the details and interactions. The instructor will focus on student comprehension checks. Different fundamental natural laws may characterize chemical

processes. In that way, however, theoretical abstraction and rationale must be formulated and processed. Mathematical models often need quantitative formulas [30]. It is necessary to represent mathematically because students can easily solve abstract chemical issues [31]. Students also face a problem in chemistry with the aid of mathematical equations, which needs quantitatively to be solved to learn the skill of representing chemistry.

The goal of this research is to increase student information literacy ability by Google Classroom online learning. The research problems are: i) How is the impact of online learning through the Google Classroom on increasing student information literacy? ii) How is student perception of online learning through the Google Classroom is implemented?

2. RESEARCH METHOD

2.1. Design of research

The quantitative analysis design of this study included pre and post measuring of the learning outcomes of the respondents. The experimental design of this study was a one group pretest-posttest design [32]. The research design of this study is shown in Table 1. Teachers use Google Classroom for posting questions, connections, power points, photos, documents, games, guides, and tests. Students work on Google Classroom computers every day, such as daily question, power points, images, quests online, Google Docs, sports.

Table 1. Design of research

Subject	Pretest	Posttest
One group	O ₁	O ₂

O₁=pretest value before online learning through the Google Classroom

O₂=posttest value after online learning through the Google Classroom

2.2. Participant

This research involved 65 students from the Chemistry Course under the Biochemistry Program, Faculty of Science, Engineering at the Universitas Pendidikan Mandalika (UNDIKMA), Mataram, Indonesia. The courses included two hours theory and one-hour weekly courses. The tutorial includes teaching activities, lectures, and practical presentations. This is a precondition for LMS institutions, especially for online learning. Therefore, over the last six months or in another area both students have experience with LMS. However, the platform now provides little engagement and an exciting learning experience for many students, in particular. To that end, students have to download the Google Classroom application at the beginning of the semester. Registration for Google Classroom is compulsory. Teaching materials were available for students via slides and mobile (PDF) or YouTube videos before their lesson. Reading content was downloaded from student's mobile devices and read offline. The theory course conducted in a classroom with several students in order to improve their interaction with them was decisive in the advancement of the software requirements specification (SRS) into the Google Classroom. Also, relevant materials were submitting, handling, analyzing, and collecting feedback. An easy way to synchronize publications, correspondence, and note was another benefit of using the Google Classroom. These data are available through intelligent devices, and therefore Information must be disseminated promptly.

2.3. Research instruments

For this study, data in Google Form and questionnaire items were collected. Items are based on the evaluation model LMS, which tests students' commitment to content, communication, and the delivery of tasks. Students were questioned at the end of the semester. The test used to investigate the ability to read information was a fair query with many options. The questionnaire for student interpretation in Google Classroom focused on online learning consists of 18 statements. The tool is translated into Indonesian and reviewed by three Indonesian lecturers for the accuracy of the queries. A pilot test was then conducted to assess the questionnaire's reliability and validity. The distribution of information on questionnaire literacy ability is provided in Table 2.

2.4. Validity of the information literacy instrument

An expert validates the information literacy instrument prior to implementation. The method has been validated with 1-5 Likert scale objects (1=invalid to 5=very valid). As shown in Table 3, the score obtained from validators is converted into five-dimensional qualitative data [33].

Table 2. Aspect of information literacy

Component of information literacy	Indicator of information literacy	Items
Intermediate	– Define the relevant details	1, 2, 3, 4, 5, 6,
	– Select the most suitable information for the necessary information	7, 8, 9, 10
	– Interpret the visual data (i.e. graphs, tables, diagrams)	
	– Submit a research report	
	– Preparation of bibliography	
	– Build bibliographic records for various content types (i.e. books, articles, thesis, web pages)	
	– Create quotes and use quotes in the document	
	– Learn from success in problem solving	
	– Using various types of printed sources (i.e. books, periodicals, encyclopaedias, chronologies)	10, 11, 12, 13, 14, 15, 16, 17,
	– Using electronic sources of information	18, 19, 20
Basic	– Locate in the library information sources	
	– Using the list of libraries	
	– Using the library catalogue to locate tools in the library	
	– Synthesize information newly obtained with previous information	21, 22, 23, 24, 25, 26, 27, 28, 29, 30
Advanced	– Determine the material and the sections of a presentation (i.e. introduction, conclusion) (written, oral)	
	– Create and arrange bibliographic records	
	– Critique of the efficiency of the quest process and its items	

Table 3. Criteria for the validity of the information literacy instrument

Validity interval (Va)	Criteria
Va>4.21	Very valid
3.40<Va<4.21	Valid
2.60<Va<3.40	Quite valid
1.79<Va<2.60	Less valid
Va<1.79	Invalid

2.5. Data analysis

The questionnaire comprises two variables: information literacy ability and students' perception of online learning through the Google Classroom. The survey was administered in one day to the participant. Each participant was requested to respond by a 5-point Likert scale (1=strongly disagree to 5=strongly agree). The questionnaire was distributed in August-September, 2020 using the Google Form. The gain of student information literacy was calculated based on the standardized T-test and Hake (1) score gain in this study with the assistance of SPSS 23.

$$\%g = \frac{\%Sf - \%Si}{100 - \%Si} \times 100\% \quad (1)$$

Where:

g=normalized gain

Sf=posttest score

Si=pretest score

Calculation results <g> are then seen in three classes of Hake [34] as shown in Table 4. The criteria to determine student perceptions regarding the use of Google Classroom [35] is shown in Table 5.

Table 4. Gain classification

Average gain	Criteria
0.00<g≤0.30	Low
0.30<g≤0.70	Medium
0.70<g≤1.00	High

Table 5. Student perception standard

Perception standard (%)	Criteria
0-20	Very negative
21-40	Negative
41-60	Netral
61-80	Positive
81-100	Very positive

3. RESULTS AND DISCUSSION

In this study, the instrument used to measure students' information literacy ability was tested for expert validity and through SPSS 23 analysis. The results obtained from the expert test were 4.22% which indicated that the overall information literacy instrument was in the very valid category. The results of the instrument validation can be seen in Table 6. The test results using SPSS 23 show that all the 30 items are considered valid, as shown in Table 7. The instrument used to measure information literacy ability was also analyzed using SPSS 23 (Cronbach's alpha) to determine the reliability of the instrument. The results showed that the reliability coefficient of the items is 0.86, as shown in Table 8 with very high criteria.

Table 6. The results of validation for information literacy instrument by experts

No	Feasibility indicators	Score percentages (%)	Category
1	Content	4.20	Valid
2	Language	4.24	Strongly valid
3	Presentation	4.22	Strongly valid
	Average values	4.22	Strongly valid

Table 7. The instrument validity from information literacy

Items	Pearson correlation	Sig. (2-tailed)	Category
1	.655**	.001	Valid
2	.865**	.001	Valid
3	.483**	.002	Valid
4	.565**	.000	Valid
5	.551**	.002	Valid
6	.566**	.001	Valid
7	.566**	.003	Valid
8	.555**	.004	Valid
9	.541**	.002	Valid
10	.554**	.001	Valid
11	.583**	.000	Valid
12	.627**	.001	Valid
13	.682**	.001	Valid
14	.746**	.001	Valid
15	.552**	.003	Valid
16	.876**	.001	Valid
17	.516**	.002	Valid
18	.656**	.001	Valid
19	.544**	.002	Valid
20	.521**	.002	Valid
21	.530**	.002	Valid
22	.590**	.000	Valid
23	.729**	.001	Valid
24	.541**	.002	Valid
25	.544**	.001	Valid
26	.646**	.001	Valid
27	.526**	.002	Valid
28	.647**	.003	Valid
29	.876**	.001	Valid
30	.555**	.000	Valid

Table 8. The reliability coefficient of information literacy coefficient

Cronbach's Alpha	N of items
0.86	30

3.1. The implementation of online learning through the Google Classroom

Google online learning process involves preliminary work, core tasks, and closing activities. The initial action was intended for students using an online learning media program in the Google Classroom. Students need to learn and talk through the Google Classroom in key activities. In contrast, the lecturer can supply a virtual laboratory for biochemistry practice in the Google Classroom. Students participate in the observation and study process individually. Students may also share their views at the closing events, complete the studied material, and conduct tasks at the end of each meeting.

The COVID-19 pandemic that demanded online learning did not enable lectures to be held on face-to-face basis. Researchers addressed online teaching through Google Classroom in this study. The Google Classroom method for the introduction of online learning requires time to start training. The teacher requests students to provide their information and email address via Google Classroom for the online learning process. This is to encourage teachers to register Google classes to train students to interact directly with teachers and peers. The description of the biochemistry material taught includes: i) Structure, properties, and chemical reactions of hydrocarbons; ii) Aerobic and anaerobic metabolism; iii) Citric acid cycle; iv) Respiration and energy chains (ATP); v) Disorders of carbohydrate metabolism; vi) Oxidation and energy structures in lipid; vii) Metabolism of ketone compounds; viii) Lipid biosynthesis; ix) Structure, properties, and reactions of vitamins & minerals; x) Genetic knowledge bias and flow in living systems.

3.2. The impact of the Google Classroom on increasing student information literacy ability

The data collected on students' information literacy before and after their online learning using Google Classroom are shown in Table 9. The table shows that mean $X=77$ in online learning and Mean $X=73$ in learning without online. This means that the average information literacy ability of students is higher through the use of Google Classroom than face-to-face so that the difference between the arithmetic mean is significant at α meaning-degree, the accompanying T-test analysis was carried out, and Table 10 shows the results of the analysis.

Table 9. Descriptive statistics of students' pretest and posttest information literacy abilities

Group	N	Mean	Std. Deviation	Std. Error mean
Pretest	65	73	5.60	.989
Posttest	65	77	5.36	.947

Table 10. Results of the t-test analysis on information literacy ability

		Levene's test for equality of variances		T-test for equality of means	
		F	Sig.	T	Df
Information literacy	Equal variances assumed	.971	.328	3.2	62
	Equal variances not assumed			3.2	61.8

The p-value equal to $0.002 < 0.05$ can be seen in Table 9. It shows a substantial statistical difference in students' information literacy before and after learning via Google Classroom. The N-Gain test was performed to assess the increase in student knowledge literacy prior to and after Google Classroom usage and the results are presented in Table 11.

Table 11. Recapitulation results from N-gain

No.	Group	N	Ideal score	Value		N-Gain
				Minimum value	Maximum value	
1.	Pretest	60	100	50	60	0.33
2.	Post test	65	100	60	80	

The student information literacy is improved based on the results shown in Table 11. The observed pretest and post-test levels of N-Gain were in the range of 0.33 with the average category. It has been found in this study that online learning based on Google Classroom is effective in improving students' information literacy ability. This is evidenced by the results of student information literacy online through Google Classroom, which is 77 while non online (conventional) is 73. The reason for online learning based on Google Classroom is effective in improving students' information literacy skills because it can be done in

several ways: i) Training intermediate information skills students in obtaining the needed information sources; ii) Training students' basic information skills in using information sources; and iii) Training students' advanced abilities in determining valid information sources. The findings obtained are consistent with research carried out by [36], in which the use of technologies like e-text and e-library has made students feel better as they can offer successful, innovative, and updated submissions. Previous study [37] found that students who make comprehensive and intensive use of technology appear to adapt learning strategies rapidly with different technical resources to help the learning process. Dolenc and Šorgo [38] showed that literacy of knowledge has a positive influence on academic performance. Information literacy can lead to productive activities through software and computer programs, including word processing and worksheets [39]. Mustofa *et al.* [40] described the results of research on the use of information literacy in different schools, which emphasizes various important points, including giving students room to choose topics, encouraging flexibility in the learning process, and growing communication capabilities among students by using modern technologies.

3.3. Student perception of the Google Classroom implemented

Student learning expectations identify student views on the learning model used during the training phase. Table 12 presents the findings of a student perception study on online learning using Google Classroom. The table shows that overall experiences of students from Google Classroom are positive. This is seen in the declaration indicators, specifically: i) Want to read were 46% answered agree; Lecture content easy to understand were 50% answered agree; ii) Encouraged to learn were 62.5% answered agree; iii) Reason for solving the problem were 68.75% answered agree; iv) Recognized and sharing your view were 75% answered agree; v) Learn to be autonomous were 37.5% answered agree; and vi) Acknowledgement of others from 80% to agree.

The results showed that students in Google Classroom have very positive view. The student experienced better in online learning. Megawanti [41] stated that online learning is an internet network online learning technique. As online learning makes listening to the learning process easier by using Android phones, tablets, or computers rather than only listening to the books an enjoyable learning technique for the students [42]–[44]. Students may also become less bored, interested, and involved in education by student learning with online learning [45]. Effective and enjoyable learning is based on students to actively engage in the learning process [46]. Online learning may enhance readability, build constructive perspectives, promote class discussions and improve the ability to read and think critically [47]–[49].

Table 12. Online learning perceptions students use Google Classroom

No.	Indicators	Statement (%)	Category
1	Want to read	100	Very positive
2	Lecture content easy to understand	98	Very positive
3	Encouraged to learn	96	Very positive
4	Reason for solving the problem	98	Very positive
5	Recognized and sharing your view	96	Very positive
6	Learn to be autonomous	100	Very positive
7	Acknowledgement of others	100	Very positive
	Average values	98	Very positive

4. CONCLUSION

Online learning through Google Classroom greatly influenced students' information literacy capabilities. It showed that the Google Classroom is much more effective than traditional learning. This study impacts how an efficient learning process can be implemented using Google Classroom. Policymakers may consider this for potential applications of the learning methods. Suggestions for future researchers to conduct similar research to investigate the Google Classroom learning effectiveness, especially in assessing information literacy from other learning areas such as digital literacy.

ACKNOWLEDGEMENTS

Authors acknowledge to LPPM UNDIKMA for funding this research through DIPA UNDIKMA (No: 051.A/L1/HK/UNDIKMA/2021).




REFERENCES

- [1] S. C. Kong *et al.*, “E-learning in school education in the coming 10 years for developing 21st century skills: Critical research issues and policy implications,” *Journal of Educational Technology & Society*, vol. 17, no. 1, pp. 70–78, 2014.
- [2] S. C. Kong, “Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy,” *Computers & Education*, vol. 78, pp. 160–173, Sep. 2014, doi: 10.1016/j.compedu.2014.05.009.
- [3] M. Gross and D. Latham, “What’s skill got to do with it?: Information literacy skills and self-views of ability among first-year college students,” *Journal of the American Society for Information Science and Technology*, vol. 63, no. 3, pp. 574–583, 2012, doi: 10.1002/asi.21681.
- [4] T. Koltay, “The media and the literacies: media literacy, information literacy, digital literacy,” *Media, Culture & Society*, vol. 33, no. 2, pp. 211–221, Mar. 2011, doi: 10.1177/0163443710393382.
- [5] C. Martin, “An information literacy perspective on learning and new media,” *On the Horizon*, vol. 19, no. 4, pp. 268–275, Sep. 2011, doi: 10.1108/10748121111179394.
- [6] A. M. J. White, “Information Literacy and Critical Thinking in Higher Education,” in *Research Anthology on Developing Critical Thinking Skills in Students*, IGI Global, 2019, pp. 367–381.
- [7] D. Dolničar and B. B. Podgornik, “Information Literacy of University Freshmen, and Differences in ICT Use, Internet Confidence and Motivation,” in *European Conference on Information Literacy*, 2018, pp. 254–263.
- [8] A. De Meulemeester, J. De Maeseneer, S. De Maeyer, R. Peleman, and H. Buysse, “Information Literacy Self-Efficacy of Medical Students: A Longitudinal Study,” in *European Conference on Information Literacy*, Springer, 2019, pp. 264–272.
- [9] A. Novo and G. Bastos, “Information Literacy in Portuguese School Libraries: A Longitudinal Study of Master Degree Dissertations,” in *European Conference on Information Literacy*, Springer, 2019, pp. 273–281.
- [10] I. Blau and T. Shamir-Inbal, “Digital competences and long-term ICT integration in school culture: The perspective of elementary school leaders,” *Education and Information Technologies*, vol. 22, no. 3, pp. 769–787, 2017, doi: 10.1007/s10639-015-9456-7.
- [11] Z.-J. Zhong, “From access to usage: The divide of self-reported digital skills among adolescents,” *Computers & Education*, vol. 56, no. 3, pp. 736–746, Apr. 2011, doi: 10.1016/j.compedu.2010.10.016.
- [12] J. Littenberg-Tobias and J. Reich, “Evaluating access, quality, and equity in online learning: A case study of a MOOC-based blended professional degree program,” *The Internet and Higher Education*, vol. 47, p. 100759, Oct. 2020, doi: 10.1016/j.iheduc.2020.100759.
- [13] S. Barzilai and Y. Eshet-Alkalai, “The role of epistemic perspectives in comprehension of multiple author viewpoints,” *Learning and Instruction*, vol. 36, pp. 86–103, Apr. 2015, doi: 10.1016/j.learninstruc.2014.12.003.
- [14] E. Porat, I. Blau, and A. Barak, “Measuring digital literacies: Junior high-school students’ perceived competencies versus actual performance,” *Computers & Education*, vol. 126, pp. 23–36, Nov. 2018, doi: 10.1016/j.compedu.2018.06.030.
- [15] K. B. Al Bataineh, A. A. Ahmed Banikalef, and A. H. Albashtawi, “The Effect of Blended Learning on EFL Students’ Grammar Performance and Attitudes: An Investigation of Moodle,” *SSRN Electronic Journal*, vol. 10, 2019, doi: 10.2139/ssrn.3367595.
- [16] A. H. Albashtawi and K. B. Al Bataineh, “The Effectiveness of Google Classroom Among EFL Students in Jordan: An Innovative Teaching and Learning Online Platform,” *International Journal of Emerging Technologies in Learning (iJET)*, vol. 15, no. 11, p. 78, Jun. 2020, doi: 10.3991/ijet.v15i11.12865.
- [17] A. Margaryan, A. Littlejohn, and G. Vojt, “Are digital natives a myth or reality? University students’ use of digital technologies,” *Computers & Education*, vol. 56, no. 2, pp. 429–440, Feb. 2011, doi: 10.1016/j.compedu.2010.09.004.
- [18] I. Esteban-Millat, F. J. Martínez-López, M. Pujol-Jover, J. C. Gázquez-Abad, and A. Alegret, “An extension of the technology acceptance model for online learning environments,” *Interactive Learning Environments*, vol. 26, no. 7, pp. 895–910, Oct. 2018, doi: 10.1080/10494820.2017.1421560.
- [19] L. Abazi-Bexheti, A. Kadriu, M. Apostolova-Trpkovska, E. Jajaga, and H. Abazi-Alili, “LMS Solution: Evidence of Google Classroom Usage in Higher Education,” *Business Systems Research Journal*, vol. 9, no. 1, pp. 31–43, Mar. 2018, doi: 10.2478/bsrj-2018-0003.
- [20] P. Jakkaew and S. Hemrungrrote, “The use of UTAUT2 model for understanding student perceptions using Google Classroom: A case study of Introduction to Information Technology course,” in *2017 International Conference on Digital Arts, Media and Technology (ICDAMT)*, 2017, pp. 205–209, doi: 10.1109/ICDAMT.2017.7904962.
- [21] L. R. Halverson, K. J. Spring, S. Huyett, C. R. Henrie, and C. R. Graham, “Blended Learning Research in Higher Education and K-12 Settings,” in *Learning, Design, and Technology*, Cham: Springer International Publishing, 2017, pp. 1–30.
- [22] G. Northey, T. Bucic, M. Chylinski, and R. Govind, “Increasing Student Engagement Using Asynchronous Learning,” *Journal of Marketing Education*, vol. 37, no. 3, pp. 171–180, Dec. 2015, doi: 10.1177/0273475315589814.
- [23] W. P. Janzen, “Screening Technologies for Small Molecule Discovery: The State of the Art,” *Chemistry & Biology*, vol. 21, no. 9, pp. 1162–1170, Sep. 2014, doi: 10.1016/j.chembiol.2014.07.015.
- [24] K. Beaumont, “Google Classroom: An online learning environment to support blended learning,” *Compass: Journal of Learning and Teaching*, vol. 11, no. 2, Dec. 2018, doi: 10.21100/compass.v11i2.837.
- [25] Abd. Syakur, Sugirin, and Widiarni, “The Effectiveness of English Learning Media through Google Classroom in Higher Education,” *Britann International of Linguistics Arts and Education (BioLAE) Journal*, vol. 2, no. 1, pp. 475–483, Mar. 2020, doi: 10.33258/biolae.v2i1.218.
- [26] F. I. Amadin, A. C. Obieniu, and R. O. Osaseri, “Main barriers and possible enablers of Google apps for education adoption among university staff members,” *Nigerian Journal of Technology*, vol. 37, no. 2, p. 432, Jul. 2018, doi: 10.4314/njt.v37i2.18.
- [27] M. M. Jordan and N. D. Duckett, “Universities confront ‘Tech Disruption’: Perceptions of student engagement online using two learning management systems,” *The Journal of Public and Professional Sociology*, vol. 10, no. 1, p. 4, 2018.
- [28] L. Dassa and M. Vaughan, “#Class Again? How Education Faculty Engage the Disengaged College Student,” *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, vol. 91, no. 1, pp. 42–45, Jan. 2018, doi: 10.1080/00098655.2017.1342434.
- [29] A. Gupta and P. Pathania, “To study the impact of Google Classroom as a platform of learning and collaboration at the teacher education level,” *Education and Information Technologies*, vol. 26, no. 1, pp. 843–857, Jan. 2021, doi: 10.1007/s10639-020-10294-1.
- [30] K. Bain, J.-M. G. Rodriguez, A. Moon, and M. H. Towns, “The characterization of cognitive processes involved in chemical kinetics using a blended processing framework,” *Chemistry Education Research and Practice*, vol. 19, no. 2, pp. 617–628, 2018, doi: 10.1039/C7RP00230K.




- [31] R. Moreno, G. Ozogul, and M. Reisslein, "Teaching with concrete and abstract visual representations: Effects on students' problem solving, problem representations, and learning perceptions.," *Journal of Educational Psychology*, vol. 103, no. 1, pp. 32–47, 2011, doi: 10.1037/a0021995.
- [32] Sugiyono, *Quantitative, qualitative and R&D research methods*. Bandung: Alfabeta, 2014.
- [33] C. A. Dewi and R. A. Mashami, "The Effect of Chemo-Entrepreneurship Oriented Inquiry Module on Improving Students' Creative Thinking Ability," *Journal of Turkish Science Education*, vol. 16, no. 2, pp. 253–263, 2019.
- [34] C. A. Dewi, "Improving creativity of prospective chemistry teacher through chemoentrepreneurship oriented inquiry module on colloid topics," *Journal of Physics: Conference Series*, vol. 1156, no. 1, p. 012017, Jan. 2019, doi: 10.1088/1742-6596/1156/1/012017.
- [35] C. A. Dewi, "The Effectiveness of Blended Learning in Problem-Based Learning (PBL) on Learning Activities of IKIP Mataram Students on Environmental Pollution Materials," *Hydrogen: Jurnal Kependidikan Kimia*, vol. 1, no. 1, pp. 8–13, 2013, doi: 10.33394/hjkk.v1i1.573.
- [36] J. Kranzow and N. Hyland, "Marketing Climate: New Considerations for Target Marketing in Graduate Student Enrollment Management," *Journal of College Admission*, vol. 211, pp. 22–25, 2011.
- [37] L. Pareto and S. Willermark, "Educational technology in teaching: What do teachers perceive they need in order to develop their professional competence?" in *IRIS 36*, 2013, pp. 1–16.
- [38] B. Sezer, "Implementing an information literacy course: Impact on undergraduate medical students' abilities and attitudes," *The Journal of Academic Librarianship*, vol. 46, no. 6, p. 102248, Nov. 2020, doi: 10.1016/j.acalib.2020.102248.
- [39] K. Dolenc and A. Sörgo, "Information literacy capabilities of lower secondary school students in Slovenia," *The Journal of Educational Research*, vol. 113, no. 5, pp. 335–342, Aug. 2020, doi: 10.1080/00220671.2020.1825209.
- [40] F. Fredy, L. A. Prihandoko, and A. M. Anggawirya, "The Effect of Learning Experience on the Information Literacy of Students in the Ri-Png Border During Covid-19 Period," *International Journal of Multicultural and Multireligious Understanding*, vol. 7, no. 10, p. 171, Nov. 2020, doi: 10.18415/ijmmu.v7i10.2067.
- [41] M. I. Mustofa, M. Chodzirin, L. Sayekti, and R. Fauzan, "The formulation of the online lecture model as an effort to reduce the disparity in the quality of higher education," *Walisongo Journal of Information Technology*, vol. 1, no. 2, p. 151, Dec. 2019, doi: 10.21580/wjit.2019.1.2.4067.
- [42] P. Megawanti, "Students Perceptions toward of distance learning during the Covid 19 Pandemic," *Jurnal Faktor UNINDRA*, vol. 7, no. 2, pp. 75–82, 2020, doi: 10.30998/fjik.v7i2.6411.
- [43] C. A. Dewi and A. Ahmadi, "The Effect of Savi Learning Based on Interactive Simulation Media on Students' Critical Thinking Skills on Electrochemical Materials," *Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram*, vol. 2, no. 1, p. 8, Jun. 2014, doi: 10.33394/j-ps.v2i1.1049.
- [44] Ahmadi and C. A. Dewi, "The Effect of SAVI Learning Based on Interactive Simulation Media on Students' Concept Understanding on Electrochemical Materials," *Jurnal Ilmiah Pendidikan Kimia "Hydrogen,"* vol. 2, no. 1, pp. 144–148, 2014, doi: 10.33394/hjkk.v2i1.641.
- [45] S. Wida, "Student Responses to the Online Course Learning Process," *Child Education Journal*, vol. 2, no. 1, pp. 48–52, Jun. 2020, doi: 10.33086/cej.v2i1.1506.
- [46] S. Suhartono, I. N. S. Degeng, I. Suyitno, and S. Sulton, "A Comparison Study: Effects of the Group Investigation Model and Direct Instruction Model toward Science Concept Understanding," *Jurnal Pendidikan IPA Indonesia*, vol. 8, no. 2, pp. 185–192, Jun. 2019, doi: 10.15294/jpii.v8i2.18135.
- [47] H. Cakir, "Use of blogs in pre-service teacher education to improve student engagement," *Computers & Education*, vol. 68, pp. 244–252, Oct. 2013, doi: 10.1016/j.compedu.2013.05.013.
- [48] C. A. Dewi, P. Pahriah, and A. Purmadi, "The Urgency of Digital Literacy for Generation Z Students in Chemistry Learning," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 16, no. 11, p. 88, Jun. 2021, doi: 10.3991/ijet.v16i11.19871.
- [49] M. Erna, E. Elfizar, and C. A. Dewi, "The Development of E-Worksheet Using Kvisoft Flipbook Maker Software Based on Lesson Study to Improve Teacher's Critical Thinking Ability," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 15, no. 01, p. 39, Jan. 2021, doi: 10.3991/ijim.v15i01.15679.

BIOGRAPHIES OF AUTHORS







Citra Ayu Dewi    is a senior lecturer in the Chemistry Education Department of Applied Science and Technique Faculty of Universitas Pendidikan Mandalika, Mataram, Indonesia. She received a Bachelor of Chemistry Education degree in 2009 from IKIP Mataram, and Master degree in Chemistry Education in 2012 from Universitas Negeri Malang. Her research interest includes: developing model and media of learning, computer and internet-based learning, blended learning, and mobile learning, ethnoscience, creative & critical thinking, and literacy. She can be contacted at: ayudewi_citra@ikipmataram.ac.id.







Muhali    is a lecturer in the Chemistry Education Department of Applied Science and Technique Faculty of Universitas Pendidikan Mandalika, Mataram, Indonesia. His research focuses on Chemistry education, Chemistry Learning Evaluation, Philosophy of Science, Chemical Education Research Methods, Transformation Geometry, and Chemical Bond. He can be contacted at email: Muhali@ikipmataram.ac.id.







Yeti Kurniasih     is a lecturer in the Chemistry Education Department of Applied Science and Technique Faculty of Universitas Pendidikan Mandalika, Mataram, Indonesia. Her current research interest includes Fundamentals of Analytical Chemistry, Chemical Separation, Spectroscopy, Physical Inorganic Chemistry, Chemical Environment, and Modern Physics. She can be contacted at email: yetikurniasih@ikipmataram.ac.id.



Diah Lukitasari     is a lecturer in Universitas Pendidikan Mandalika, Mataram, Indonesia. Her current research interest includes Socialization, Nonclinical Risk, Counseling, Information Services, Advanced Studies, Literacy, and Scientific articles. She can be contacted at email: diahlukitasari@ikipmataram.ac.id.



Abdul Sakban     is a senior lecturer in the Pancasila and Civic Education Department of Teacher Training and Education Faculty of Universitas Muhammadiyah Mataram, Mataram, Indonesia. Author received a Bachelor of Pancasila and Civic Education Department degree in 2012 from Universitas Muhammadiyah Mataram, and Master degree in Social Science: Law and Civic Education in 2015 from Universitas Negeri Makassar. Her research interest includes: Cyberbullying, Intolerance, Customary law, Civic Education, and Pancasila. He can be contacted at email: sakban.elfath@yahoo.co.id.