Student Perceptions of Online-Based Chemistry Learning Implementation during the Covid-19 Pandemic

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Abstract: This study explains chemistry students' perceptions of online-based chemistry learning during the Covid-19 pandemic. The descriptive quantitative survey method was used for the research. The research was carried out at 16 universities in Indonesia in the Chemistry Education Study Program involving 311 students. A survey technique with a Likert scale was used to collect data. The survey form was created using a Google Forms questionnaire, making it easier for students to access. The data analysis technique utilized in this study was to determine the percentage of data from each questionnaire indication from the disseminated Google form, then interpret it into a data presentation score and analyze each indicator in depth. The results showed that students' perceptions of online-based chemistry learning in chemistry education study programs at 16 universities in Indonesia were in poor criteria, this was obtained from the percentage score on the online enjoy learning indicator by 50%, the content presentation strategy indicator 40%, online media indicators used are 65%, indicators are constrained when online learning is 20%, student readiness indicators are 21% and online learning evaluation indicators are 60%. This research is expected to be a reference for evaluating various parties in online-based chemistry learning, especially regarding students' perceptions of fun learning activities. This study also discusses the problematic tendencies of online-based chemistry learning, namely (1) students' motivation decreases due to boring learning, (2) students' understanding of concepts is reduced because the presentation of learning content is less than optimal, (3) students' readiness to participate in online learning is very lacking because have no previous online learning experience. As a result, the findings of this study can be used as evaluation material in analyzing and developing online learning models during the Covid-19 pandemic.

Keywords: Chemistry learning; Online learning; Students' perception

Introduction

Nowadays, we face a different way of life. At the end of 2019, the emergence of the covid-19 virus in Wuhan, china resulted in massive changes (Onyema et al., 2020). This virus causes respiratory system failure in humans and spreads so quickly that it can be fatal. There has been no conclusive evidence of the virus's origin until now. Each country has implemented a lockdown and social distancing strategy to prevent the virus from spreading. This decision paralyzed several industries, including education (Wijaya et al., 2020; AlMahdawi et al., 2021). As of June 29, 2020, school closures had impacted over one billion kids, or 61 percent of the global student population (UNESCO, 2020). Face-to-face classes have been forced to end, and schools are gradually transitioning to online learning. On March 24, 2020, according to the Indonesian ministry of education and culture's circular no. 4 of 2020 concerning the implementation of education policies in the emergency

period for the spread of Coronavirus disease, learning activities are carried out from home through online learning to provide meaningful learning experiences for students and complete learning objectives. Teachers who are used to giving lectures in front of a classroom must adjust to online learning, which can be done synchronously or asynchronously (Landicho, 2021; Sarkar et al., 2021).

Online learning is a type of learning that makes use of the internet to provide access, connectivity, flexibility, and the ability to create a wide range of learning activities (Moore et al., 2011). According to the research of Eldeeb (2014), the internet and multimedia technologies have the potential to change the way knowledge is communicated and be utilized as a substitute for traditional classroom learning. Before the epidemic, several universities tried using online learning technologies like e-learning. As a result, online learning has various advantages, including ease, flexibility, time savings, teamwork, and the ability to engage with others without the constraints of geography and time (Hung et al., 2010; Dwikurnaningsih & Waruwu, 2021). Online learning also allows students to take advantage of Internet resources, enhance their knowledge, and not be constrained by geography or time (Dewi et al., 2021). Furthermore, students will have greater influence over their learning activities and will be able to make more flexible selections about their homework (Rafique et al., 2021). Rosdiana et al. (2018) indicated that learning vibrations and waves through online learning is the best way to improve problem-solving and graphing skills in future science instructors. However, when the online system is used in a large-scale manner, such as during the current epidemic, it can lead to a variety of problems.

Chemistry education is one type of education that employs science to attain educational objectives, particularly chemistry-related objectives. Chemistry is a great subject to learn if you want to improve your skills (skills, maintaining attitudes, and developing mastery of concepts related to everyday experience) (Dewi et al., 2022; Erna et al., 2021). Willy nilly, these subjects must be delivered to students online without compromising their essence. This learning system's adjustment must be carefully considered so that learning can proceed smoothly. The most important aspect of implementing online education for students is to pay attention to various aspects in order to achieve learning objectives (Arizona et al., 2020; Kipp, 2021). Online learning entails students and even parents converting their personal space at home into a study and workspace. The majority of classroom activities will take place online, with virtual classrooms, online discussion boards, and video conferencing serving as platforms for communication

and interaction. Furthermore, both professors and students are required to participate in online platforms (Umalakshmi, 2021; Khuluqo et al., 2021). It is evident that online learning is the ideal solution for a once in a life time circumstance like the current pandemic situation. However, there are significant flaws in this study. Chung et al. (2020) Say Argue that students can't connect directly with online learning, or that the same kind of social interaction that occurs in a classroom doesn't happen online. These issues might make students feel as if they are missing out, resulting in lower student engagement and interaction, as well as a poor learning experience.

There has been a lot of work done in chemistry learning using a blended learning method, but fully implemented online chemistry learning still needs to be researched. As a result, learning chemistry entails understanding the role of chemistry in various contexts of daily life, developing thinking skills, and assisting students in developing critical but positive attitudes toward chemistry and its applications (Dewi, 2019). In order to adopt online learning, human resources, such as teachers, students, and parental support, must be ready. Previous research in West Java (Fauzi & Khusuma, 2020) found that 73.9 percent of teachers believe online learning is ineffective. When using an online learning system for teaching and learning, the teacher encounters numerous issues. These issues include (1) a lack of a school facility, (2) a lack of an internet connection, and (3) the planning, execution, and evaluation of teaching and learning activities. Teachers may still be unprepared for present circumstances, and it may be claimed that while doing online teaching and learning activities during a pandemic, this is especially true.

Based on the explanation above, this study aims to explore how students' perceptions of online-based chemistry learning are viewed from 1) students' perceptions of enjoying learning through online-based chemistry learning; 2) students' perceptions of content presentation strategies in chemistry learning; 3) students' perceptions of using online media in chemistry learning; 4) students' readiness during online-based chemistry learning, 5) students' perceptions of online learning evaluations.

Method

The research method used in this research is descriptive qualitative using survey techniques. The research sample taken was all students majoring in Chemistry Education from 16 universities in Indonesia including UIN Antasari Banjarmasin, Universitas Sultan Ageng Tirtayarsa, Universitas Pendidikan Mandalika, Universitas Diponegoro, Universitas Negeri Surabaya,

UIN SATU Tulungagung, Universitas Mahaputra Muhammad Yamin, Universitas Negeri Padang, STKIP PGRISumatera Barat, Universitas Adzkia, Universitas Riau, Universitas Islam Riau, Poltekkes Kemenkes Tanjungpinang, Universitas Muhammadiyah Pontianak, Universitas Halu Oleo, Universitas Terbuka with a total of 311 students.

The instruments used were questionnaires and online interviews using the Google form. The purpose of this survey is to encourage open and honest responses from participants by providing limited information. The 25-item survey was created expressly for this research project. The first section is on demographic data. The second part deals with aspects measured during the implementation of online learning, including enjoying online learning, content presentation strategy, online media used, student readiness, and online learning evaluation. The research tools were evaluated using a five-point Likert scale (strongly agree, agree, somewhat agree, disagree, strongly disagree). Cronbach's alpha, which was assessed at 0.80, was used to determine the survey's internal consistency. The content validity was reviewed by a committee of three experts. All of the items are really important. Item-level content validity index (I-CVI)= 0.90.

Table 1. Instruments for Online-Based Chemistry Learning Surveys

Aspect	Indicator
Enjoying online learning	Have a high will, Interested and not bored, Learning motivation
Content presentation strategy	Type of presentation of teaching materials, Learning resources, Learning strategies (Model/Synchronous/Asynchronous), Learning activities/Assignments/Material deepening, Students' Level of Understanding, Teacher-Student/Student-Student Interaction
Online media used	The device used, Campus/School E-learning, Classroom, Zoom Meeting, Whatsapp, Youtube
Student readiness	IT Mastery, IT Skilled
Online learning evaluation	Google Form, Written tests

Data collection is done by filling out a Google form. The questionnaire is distributed closed because the questions in the answer column are the respondent's responses. The data set is turned into a table using the percentage algorithm. The % results are analyzed, and the percentages for each indication are based on research. We then create a narrative based on the data in the table. Following that, the findings of the study are addressed utilizing references to the effects of prior

studies and the implications of literature reviews. For more information on the survey instrument used in this study, see Table 1.

Quantitative descriptive analysis techniques were used in data analysis such as calculating averages and percentages, and qualitative data analysis techniques such as data condensation, data presentation, and retrieval and verification conclusions with the model proposed by Ridder (2014). The percentage results obtained are interpreted using the interval table 2 shown below.

Table 2. Score Interpretation Criteria (Siyoto et al., 2015)

Percentage (%)	Information
0–19.99	Very Poor
20-39.99	Not good
40-59.99	Enough
60-79.99	Well
80-100	Very good

Result and Discussion

Results
Demographic Data from Online-Based Chemistry Learning

The number of samples which became respondents in this study was 311 students consisting of 16 universities in Indonesia. Most of the respondents came from the Universitas Sultan AgengTirtayarsa (10%), Universitas Pendidikan Mandalika (14%), Universitas Negeri Surabaya (40%), UIN SATU Tulungagung (14%), Universitas MahaputraMuhammad Yamin (17%), Universitas Negeri Padang (14%), Universitas Riau (10%) (See Figure 1).
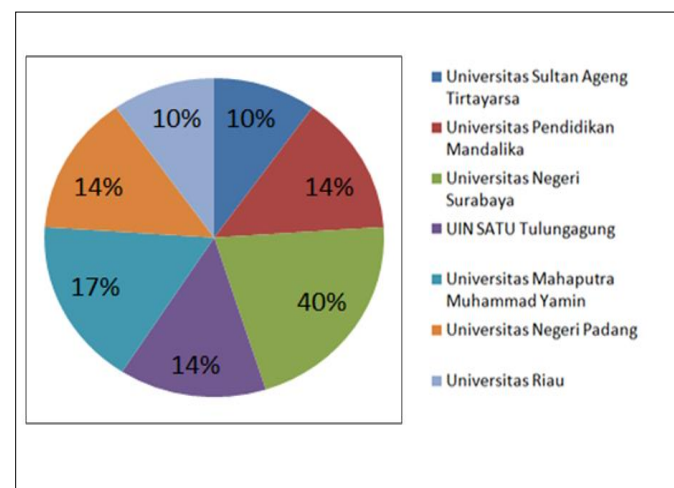

Figure 1. Demographic sample

Students who only exist at the Universitas Negeri Surabaya showed that they have complied with the rules in online-based chemistry learning during the Covid-19 pandemic. See the comparison of the number of samples

at the State University of Surabaya is the highest compared to other universities.

Students' Perceptions of Enjoying Learning through Online-Based Chemistry Learning

A Survey of students enjoying online learning was given to 311 chemistry education study program students at 16 universities in Indonesia with indicators of having a high willingness to learn online at a percentage of 50% with enough criteria, interested and not feeling bored at a percentage of 35% with not good criteria, motivation to learn at a percentage of 40% with enough criteria (See Figure 2).
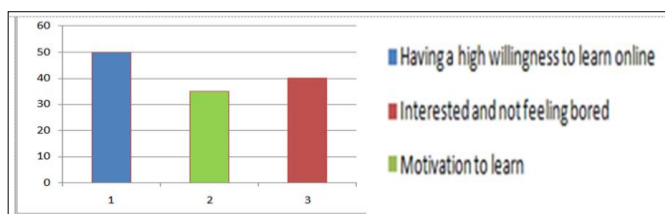

Figure 2. Enjoy online learning

Students' Perceptions of Content Presentation Strategies in Chemistry Learning

Survey of content presentation strategy online learning was given to 311 chemistry education study program students at 16 universities in Indonesia with indicators of the type of presentation of teaching materials at a percentage of 25% with not good criteria, learning resources at a percentage of 20% with not good criteria, learning strategies at a percentage of 30% with not good criteria, learning activities/ assignments/material deepening at a percentage of 35% with not good criteria, students' level of understanding at a percentage of 30% with not good criteria, teacher-Student/student-student interaction at a percentage of 37% with not good criteria (See Figure 3).
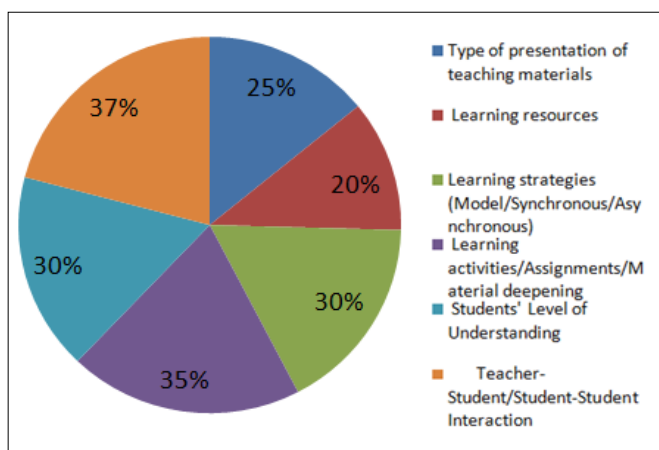

Figure 3. Content presentation strategy

Students' Perceptions of Using Online Media in Chemistry Learning

The most preferred online media by students is mobile (40%), Siakad University (51.2%), Google Classroom (15.1%), WhatsApp groups (12.3%), Youtube (10.4%), and Zoom or Google meet (4%). Students like the media because it is convenient and straightforward to use. Furthermore, because there aren't many, many quota pulses are used. Nonetheless, as suggested by student respondents in this survey study, they prefer face-to-face online meetings such as Zoom or Google Meet. It's just quotas, and due to network constraints, access is limited, so they expect the government to provide online services that are effective but not burdensome (See Figure 4).
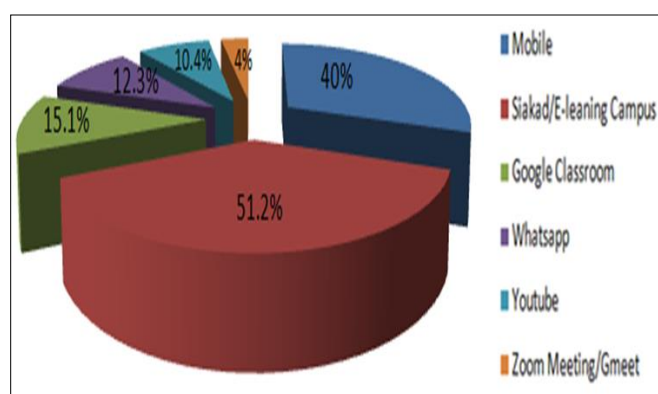

Figure 4. Online learning

Students' Readiness during Online-Based Chemistry Learning

During online-based chemistry learning during the Covid-19 pandemic, students spend most of their time using information technology as an essential skill in participating in online learning. The readiness of students to take part in online learning can be seen from the abilities and skills of students in operating technology media that are quite proficient (See Figure 5).
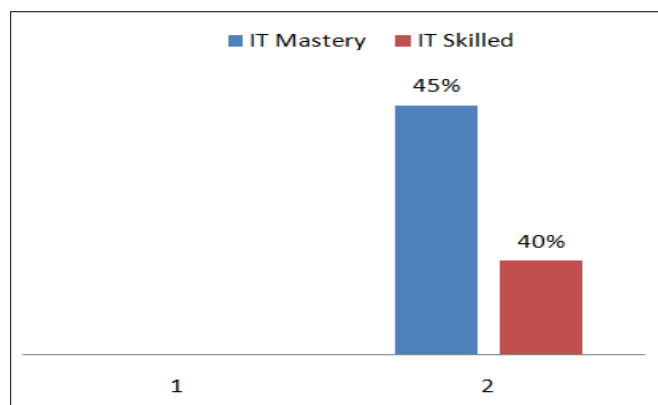

Figure 5. Student readiness

Students' Perceptions of Online Learning Evaluations

During the evaluation of online learning, it is easier for students to answer exam questions using Google forms than written tests. This can be seen from students who prefer to use Google Forms than written tests by 75%, use of Google Forms can save time than written tests by 77%, the use of Google Forms can save usage paper than the written test by 80% (See Figure 6).
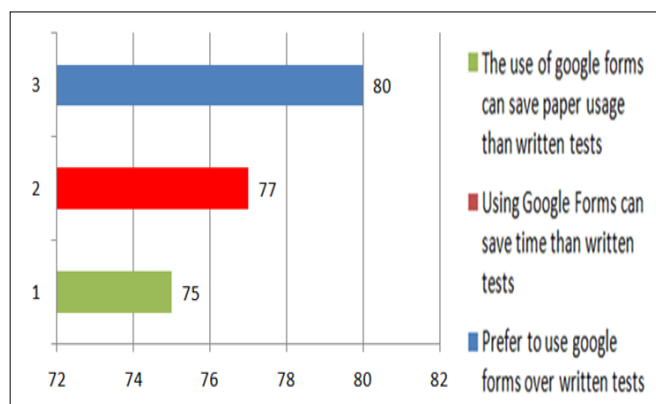

Figure 6. Online learning evaluation

Discussions

According to the study findings, students' perceptions of the implementation of online-based chemistry learning were in the poor category. This is demonstrated by the percentage score on the indicators of enjoyment of online learning was 50%, indicators of content presentation strategies were 40%, indicators of online media used was 65%, indicators of student readiness during online learning was 21%, indicators of evaluation during online learning was 60%. This indicates that implementing online-based chemistry learning during the COVID-19 pandemic tends to be problematic. This is evident from three aspects that have problematic tendencies during online learning: enjoying online learning, content presentation strategies, and student readiness during online-based chemistry learning.

The first aspect of enjoying online learning showed that most students felt that online-based chemistry learning was boring and did not help them understand the material being studied. Pavlovic et al. (2015) stated that students perceive online learning as tedious and burdensome from their research. According to Amalia et al. (2020), lack of student motivation is one of the challenges of online learning. Cahyani et al. (2020) revealed that students enrolled in online education are deteriorating in the midst of the Covid-19 pandemic of the day. This can be caused by pupils studying conditions at home for an extended period of time, causing them to become bored and sluggish.

The second aspect, online learning in its implementation, has several obstacles in content presentation strategies, including the teacher has difficulty presenting online learning-based teaching materials, the learning resources used are mostly printed versions, the learning strategies used are more asynchronous (allowing students to learn independently without any guidance process from the teacher), assignments are given to There are so many students that students have difficulty understanding in-depth the material being taught, the level of knowledge of students is primarily low. There is very little interaction between lecturers and students. According to Pavlovic et al. (2015), many pupils are against the use of online learning. The sub-indicator of instructional materials comes next. That the majority of teachers employ difficult-to-understand teaching materials in the form of books to help students understand. The teacher has not provided students with easy-to-understand instructional materials, according to the subject. According to Mustakim (2020), online learning will be more effective if the teacher uses teaching support media other than books, such as social media, to apply it. According to the report, one student's teacher only utilizes Whatsapp Group to offer homework without first giving a quick overview of the material. Study and learning activities, as well as teaching materials in learning, must be properly regulated and managed (Putri et al., 2020). Finally, educational institutions will be under more pressure to improve curricula practices, and the deployment of innovative teaching techniques and approaches will be crucial (Toquero, 2020).

The third aspect, students' readiness to participate in online-based chemistry learning, is severely lacking. Students have stated that their teacher only gives practice questions and assignments without explaining the material. Students claim that online learning is accomplished by first changing the way teachers teach; however, students have no prior experience with online learning chemical explanations. Students anticipate that the teacher will assign homework, explain the material, and discuss the work that has been completed. Online learning is more student-centered, stressing educational responsibility and empowering students to foster learning independence (Handarini & Wulandari, 2020; Sunyono & Meristin, 2021). Students may be perplexed during the learning process since the subject they must study demands a concise explanation. One approach is for teachers to optimize learning media in the form of videos and to continue to monitor students' learning progress and participation in online learning (Purwanto et al., 2020). According to Amalia et al. (2020), students have difficulty understanding learning materials because complete online learning is carried out for more

than one semester, resulting in limited interaction between teachers and students and an explanation of the material lacking optimal. According to the findings of Megawanti's research, this is because the teacher did not explain or was not clear in his explanation, and because the obstacles that occur when extending the time to study from home make it difficult for students to learn and master the subject matter (Megawanti, 2020). This is also consistent with the findings of the Owusu-Fordjour study, which found that online learning harms knowledge because many students are not accustomed to practical self-study. Due to limited internet access, most students found the newly launched e-learning platform difficult to use (Owusu-Fordjour et al., 2020; Campillo-Ferrer & Miralles-Martínez, 2021; Heng & Sol, 2021; Chiu et al., 2021; Dewi et al., 2022; Kurnia et al., 2022; Dewi & Ahmadi, 2014).

This study's contribution is to inform teachers and researchers that the implementation of online learning cannot be separated from the internet network. One of the challenges faced by students whose residence makes it difficult to access the internet is a lack of an Internet network connection, particularly those students who live in rural, remote, or disadvantaged areas. Even when someone uses a cellular network, the network can become unstable because the geographical location is still out of range of the cellular signal. This issue frequently arises in students who participate in online learning, so its implementation is ineffective. As a result, the government must establish a policy to support this online learning process by offering free online application services in collaboration with internet and application providers. In addition, the government must develop a curriculum and syllabus for online learning. For schools, it is necessary to provide technical guidance related to the operation of implementing online learning, as well as to disseminate information to teachers and students about the procedures for implementing online learning, as well as their roles and responsibilities, through print and social media.

Conclusion

Based on the study findings, it is possible to conclude those students' perceptions of the implementation of online-based chemistry learning are unfavorable, raising the possibility of problems, such as a decrease in student motivation due to boring learning. Students' conceptual understanding is reduced because the presentation of learning content is less than optimal. Students' readiness to participate in online learning is lacking because they do not have a previous online learning experience. The impact of this research is the need for optimal preparation before implementing online-based chemistry learning to avoid obstacles during the online learning process. Suggestions for future researchers need to be optimally prepared in implementing online-based chemistry learning so that the learning process is more effective and efficient. Suggestions for practitioners should take into account the use of different learning models and other alternative media in online-based chemistry learning in order to make instructional materials easy to understand for students and to create interesting chemistry learning content in order to improve students' abilities, conceptual understanding, and foster student motivation during chemistry lessons online. This survey also recommends three essential things to improve the quality of online learning, namely equipping lecturers with the skills of an interactive learning approach, equipping lecturers with technical skills using online learning facilities, and improving online learning facilities.

Author Contributions
Conceptualization, C.A.D., and A.; methodology, S.I.; formal analysis, L.S.L.P.; investigation, N.A. and C.A.D.; resources, A. and C.A.D.; data curation, C.A.D: writing—original draft preparation, C.A.D.; writing—review and editing, C.A.D.;All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest
The authors declare no conflict of interest.

References

AlMahdawi, M., Senghore, S., Ambrin, H., & Belbase, S. (2021). High school students' performance indicators in distance learning in chemistry during the COVID-19 pandemic. *Education Sciences*, *11*(11), 672. https://doi.org/10.3390/educsci11110672

Amalia, R. U., Isnaeni, B., & Hanafi, Y. (2020). Analisis kendala peserta didik dalam pembelajaran online materi biologi di Smp Negeri 3 Bantul. *Bio Education*, *5*(2), 10–15. Retrieved from https://media.neliti.com/media/publications/379316-none-e87251bd.pdf

Arizona, K., Abidin, Z., & Rumansyah, R. (2020). Pembelajaran online berbasis proyek salah satu solusi kegiatan belajar mengajar di tengah pandemi covid-19. *Jurnal Ilmiah Profesi Pendidikan*, *5*(1), 64–70. 10.29303/jipp.v5i1.111

Cahyani, A., Listiana, I. D., & Larasati, S. P. D. (2020). Motivasi belajar siswa SMA pada pembelajaran daring di masa pandemi covid-19. *IQ (Ilmu Al-Qur'an): Jurnal Pendidikan Islam*, *3*(01), 123–140. https://doi.org/10.37542/iq.v3i01.57

Campillo-Ferrer, J. M., & Miralles-Martínez, P. (2021). Effectiveness of the flipped classroom model on students' self-reported motivation and learning during the COVID-19 pandemic. *Humanities and Social Sciences Communications*, *8*(1), 1–9. https://doi.org/10.1057/s41599-021-00860-4

Chiu, T. K. F., Lin, T.-J., & Lonka, K. (2021). Motivating online learning: The challenges of COVID-19 and beyond. *The Asia-Pacific Education Researcher*, *30*(3), 187–190. https://doi.org/10.1007/s40299-021-00566-w

Chung, E., Subramaniam, G., & Dass, L. C. (2020). Online learning readiness among university students in Malaysia amidst COVID-19. *Asian Journal of University Education*, *16*(2), 45–58. https://doi.org/10.24191/ajue.v16i2.10294

Dewi, C. A. (2019). Improving creativity of prospective chemistry teacher through chemoentrepreneurship oriented inquiry module on colloid topics. In *Journal of Physics: Conference Series* (Vol. 1156, p. 12017). IOP Publishing. https://doi.org/10.1088/1742-6596/1156/1/012017

Dewi, C. A., & Ahmadi, A. (2014). Pengaruh Pembelajaran Savi Berbasis Media Simulasi Interaktif terhadap Keterampilan Berpikir Kritis Mahasiswa pada Materi Elektrokimia. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *2*(1), 8–11. https://doi.org/10.33394/j-ps.v2i1.1049

Dewi, C. A., Awaliyah, N., Fitriana, N., Darmayani, S., Setiawan, J., & Irwanto, I. (2022). Using Android-Based E-Module to Improve Students' Digital Literacy on Chemical Bonding. *International Journal of Interactive Mobile Technologies*, *16*(22). https://doi.org/10.3991/ijim.v16i22.34151

Dewi, C. A., Muhali, M., Kurniasih, Y., Lukitasari, D., & Sakban, A. (2022). The impact of Google Classroom to increase students' information literacy. *Int J Eval & Res Educ*, *11*(2), 1005–1014. https://doi.org/10.11591/ijere.v11i2.22237

Dewi, C. A., Pahriah, & Purmadi, A. (2021). The Urgency of Digital Literacy for Generation Z Students in Chemistry Learning. *International Journal of Emerging Technologies in Learning*, *16*(11), 88–103. Retrieved from https://www.learntechlib.org/p/219984/.

Dewi, C. A., Kusuma, J. M., Pahriah, P., & Syahri, W. (2022). Pengembangan Modul Digital pada Materi Struktur Atom untuk Menumbuhkan Literasi Digital Siswa. *Journal of The Indonesian Society of Integrated Chemistry (On Progress)*, *14*(2), 84–89. https://doi.org/10.22437/jisic.v14i2.19930

Dwikurnaningsih, Y., & Waruwu, M. (2021). The Effectiveness of Online Based Learning in Universities During the Covid-19 Pandemic. *Journal of Education Technology*, *5*(4), 670–677. https://doi.org/10.23887/jet.v5i4.35337

Eldeeb, R. A. (2014). Students' Perceptions to e-learning. *IOSR Journal of Research & Method in Education*, *4*(3), 33–36. Retrieved from https://www.iosrjournals.org/iosr-jrme/papers/Vol-4%20Issue-3/Version-4/G04343336.pdf

Erna, M., Dewi, C. A., & Elfizar. (2021). 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)*, *15*(01), 39–55. Retrieved from https://www.learntechlib.org/p/218684/

Fauzi, I., & Khusuma, I. H. S. (2020). Teachers' elementary school in online learning of COVID-19 pandemic conditions. *Jurnal Iqra': Kajian Ilmu Pendidikan*, *5*(1), 58–70. https://doi.org/10.25217/ji.v5i1.914

Handarini, O. I., & Wulandari, S. S. (2020). Pembelajaran daring sebagai upaya study from home (SFH) selama pandemi covid 19. *Jurnal Pendidikan Administrasi Perkantoran (JPAP)*, *8*(3), 496–503. https://doi.org/10.26740/jpap.v8n3.p496-503

Heng, K., & Sol, K. (2021). Online learning during COVID-19: Key challenges and suggestions to enhance effectiveness. *Cambodian Journal of Educational Research*, *1*(1), 3–16. Retrieved from https://rb.gy/kbyh2

Hung, M.-L., Chou, C., Chen, C.-H., & Own, Z.-Y. (2010). Learner readiness for online learning: Scale development and student perceptions. *Computers & Education*, *55*(3), 1080–1090. https://doi.org/10.1016/j.compedu.2010.05.004

Khuluqo, I. El, Ghani, A. R. A., & Fatayan, A. (2021). Postgraduate Students' Perspective on Supporting" Learning from Home" to Solve the COVID-19 Pandemic. *International Journal of Evaluation and Research in Education*, *10*(2), 615–623. https://doi.org/10.11591/ijere.v10i2.21240

Kipp, M. (2021). Impact of the COVID-19 Pandemic on the Acceptance and Use of an E-Learning Platform. *International Journal of Environmental Research and Public Health*, *18*(21), 11372. https://doi.org/10.3390/ijerph182111372

Kurnia, M. R. A., Haryanto, H., Sanova, A., & Dewi, C.

A. (2022). Studi Respon Siswa Terhadap Pengembangan Multimedia Interaktif Berbasis Chemo-Entrepreneurship Berbentuk Aplikasi Android. *Hydrogen: Jurnal Kependidikan Kimia*, *10*(1), 10–20. https://doi.org/10.33394/hjkk.v10i1.4954

Landicho, C. J. B. (2021). Changes, challenges, and opportunities in teaching senior high school earth science amidst the COVID-19 pandemic. *Journal of Learning and Teaching in Digital Age*, *6*(1), 55–57. Retrieved from https://files.eric.ed.gov/fulltext/EJ1285388.pdf

Megawanti, P. (2020). Persepsi Peserta Didik Terhadap PJJ pada Masa Pandemi Covid 19. *Faktor: Jurnal Ilmiah Kependidikan*, *7*(2), 75–82. http://dx.doi.org/10.30998/fjik.v7i2.6411

Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-Learning, online learning, and distance learning environments: Are they the same? *The Internet and Higher Education*, *14*(2), 129–135. https://doi.org/10.1016/j.iheduc.2010.10.001

Mustakim, M. (2020). Efektivitas pembelajaran daring menggunakan media online selama pandemi covid-19 pada mata pelajaran matematika. *Al Asma: Journal of Islamic Education*, *2*(1), 1–12. https://doi.org/10.24252/asma.v2i1.13646

Onyema, E. M., Eucheria, N. C., Obafemi, F. A., Sen, S., Atonye, F. G., Sharma, A., & Alsayed, A. O. (2020). Impact of Coronavirus pandemic on education. *Journal of Education and Practice*, *11*(13), 108–121. https://doi.org/10.7176/JEP/11-13-12

Owusu-Fordjour, C., Koomson, C. K., & Hanson, D. (2020). The impact of Covid-19 on learning-the perspective of the Ghanaian student. *European Journal of Education Studies*. http://dx.doi.org/10.46827/ejes.v0i0.3000

Pavlovic, M., Vugdelija, N., & Kojic, R. (2015). The use of social networks for elearning improvement. *Hellenic Journal of Music, Education and Culture*, *6*(1). Retrieved from http://hejmec.eu/journal/index.php/HeJMEC/article/view/62/55

Purwanto, A., Asbari, M., Fahlevi, M., Mufid, A., Agistiawati, E., Cahyono, Y., & Suryani, P. (2020). Impact of work from home (WFH) on Indonesian teachers performance during the Covid-19 pandemic: An exploratory study. *International Journal of Advanced Science and Technology*, *29*(5), 6235–6244. Retrieved from http://sersc.org/journals/index.php/IJAST/article/view/15627

Putri, R. S., Purwanto, A., Pramono, R., Asbari, M., Wijayanti, L. M., & Hyun, C. C. (2020). Impact of the COVID-19 pandemic on online home learning: An explorative study of primary schools in Indonesia. *International Journal of Advanced Science and Technology*, *29*(5), 4809–4818. Retrieved from http://sersc.org/journals/index.php/IJAST/article/view/13867

Rafique, G. M., Mahmood, K., Warraich, N. F., & Rehman, S. U. (2021). Readiness for Online Learning during COVID-19 pandemic: A survey of Pakistani LIS students. *The Journal of Academic Librarianship*, *47*(3), 102346. https://doi.org/10.1016/j.acalib.2021.102346

Ridder, H.-G. (2014). *Book Review: Qualitative data analysis. A methods sourcebook* (Vol. 28). Sage publications Sage UK: London, England.

Rosdiana, L., Widodo, W., Nurita, T., & Fauziah, A. N. M. (2018). E-learning task analysis making temporal evolution graphics on symptoms of waves and the ability to solve problems. In *Journal of Physics: Conference Series* (Vol. 1006, p. 12025). IOP Publishing. https://doi.org/10.1088/1742-6596/1006/1/012025

Sarkar, S. S., Das, P., Rahman, M. M., & Zobaer, M. S. (2021). Perceptions of public university students towards online classes during COVID-19 pandemic in Bangladesh. In *Frontiers in Education* (Vol. 6, p. 703723). Frontiers Media SA. https://doi.org/10.3389/feduc.2021.703723

Siyoto, S., & Sodik, M. A. (2015). *Dasar metodologi penelitian*. literasi media publishing.

Sunyono, S., & Meristin, A. (2021). The Students' Perception And Motivation To Be Prospective Chemistry Teachers Regarding Online Learning During COVID-19. *Jurnal Pendidikan MIPA*. Retrieved from http://repository.lppm.unila.ac.id/31507/

Toquero, C. M. (2020). Challenges and opportunities for higher education amid the COVID-19 pandemic: The Philippine context. *Pedagogical Research*, *5*(4). https://doi.org/10.29333/pr/7947

Umalakshmi, P. (2021). Tips and tricks to prevent back ache in online classes-covid 19 pandemic. *TNNMC Journal of Community Health Nursing*, *9*(2), 26–30. Retrieved from https://www.indianjournals.com/ijor.aspx?target=ijor:tnnmcjchn&volume=9&issue=2&article=005

UNESCO, G. (2020). Education: From disruption to recovery. *UNESCO Building Peace in the Minds of Men and Women.* Retrieved from Https://en. Unesco. Org/news/covid-19-Educational-Disruption-and-Response

Wijaya, T. T., Zhou, Y., Purnama, A., & Hermita, N. (2020). Indonesian students learning attitude towards online learning during the coronavirus pandemic. *Psychology, Evaluation, and Technology in*

Educational   Research,   *3*(1),   17–25. https://doi.org/10.33292/petier.v3ii.56