IJIS Edu : Indonesian J. Integr. Sci. Education, 7 (1) 2025

Volume 7 Issue 1 , Januari 2025
P-ISSN: **2655-2388**, E-ISSN: **2655-2450**

Students' Oral Communication Skills in Using Digital Encyclopedia of Mammals Based on Citizen Science Project

Fitri Aryanti [1,2] , Topik Hidayat [1*], Yayan Sanjaya [1], Kusnadi [1]

1 Universitas Pendidikan Indonesia, Indonesia
2 Universitas Pasundan, Indonesia
Corresponding E-mail: topikhidayat@upi.edu

Abstract: This study aimed to analyze students' oral communication skills using the Citizen Science Project (CSP) based digital encyclopedia of mammals in learning. This research combines digital technology, community involvement, and the development of scientific communication skills as a novelty. The method used was descriptive quantitative with data collection techniques through observation. The research subjects consisted of 30 prospective teacher students of the Biology Education Study Program at a private university in Bandung. The instrument used was an observation sheet on oral communication skills. The results showed that most students scored good or sufficient. The average value on indicators 1-6, namely being able to provide information or ideas by 75%, including the good category, mastering the material to be used as presentation material by 70%, including the sufficient category, delivering report results systematically and clearly by 75% including the good category, questioning skills by 70% including the sufficient category, being able to answer questions by 75% including the good category, and confidence by 70% including the sufficient category. The percentage value of the active indicator in group discussions is 95%, which is included in the very good category. Based on these data, communication skills are critical because they allow students to convey ideas, work together, and exchange information. Students' oral communication skills can be improved by continuing to train and provide opportunities for students to communicate orally on an ongoing basis based on CSP.

Keywords: Citizen Science Project, Digital Encyclopedia, Skills Oral Communication, Students

How to cite this article :

Aryanti, F., Hidayat, T., Sanjaya, Y., & Kusnadi, K. (2025). Students' Oral Communication Skills in Using Digital Encyclopedia of Mammals Based on Citizen Science Project. *IJIS Edu : Indonesian Journal of Integrated Science Education, 7*(1), 226-238. doi:http://dx.doi.org/10.29300/ijisedu.v7i1.6935

1. Introduction

21st-century learning emphasizes developing skills that meet the demands of the times, especially due to the surge of information and technological advancements. Digital technology has become an important part of everyday life, including learning, allowing for widespread access to information and innovation in learning and research (Colovic et al., 2024; Jayawardana & Gita, 2020). Communication in 21st-century learning plays a critical role in supporting the transformation of education in the digital age (Malik, 2018). Communication skills are among the skills that need to be possessed in 21st-century learning so that one can evaluate, filter, and use information and technology wisely (Latif et al., 2018; Haryanti & Suwarma, 2018; Trilling & Fadel, 2009). In addition, communication skills are the ability needed to build relationships by exchanging information or views with two or more people, and they can be improved through continuous practice or learning (Reith-Hall & Montgomery, 2022; Suhanti et al., 2018).

Oral communication is an activity that involves psychological processes such as listening comprehension, reasoning, and thinking (Rahimova, 2024). Oral communication skills are important in the learning process and interaction between students, but they also play an important role in raising awareness about biodiversity and supporting conservation efforts (Hooykaas et al., 2022). The widespread use of media and technology in all aspects of life makes communication skills even more important. Teaching communication skills can help people craft messages that are easy to understand and thoughtful to avoid misunderstandings or conflicts that may arise (Prabavathi & Nagasubramani, 2018). In addition, teaching communication skills is a significant investment that can help students communicate effectively, professionally, and ethically in digital and real life (National Education Association, 2024).

Based on classroom learning observations, students' oral communication skills are still not optimal. Observations show that some students still do not actively participate in group discussions, and some students tend to rely on their group members to complete tasks and are rarely directly involved in the learning process that requires the contribution of each member. Based on these problems, it is necessary to modify learning, one of which is using a digital encyclopedia of mammals based on the Citizen Science Project (CSP). Several studies with the CSP approach have positively impacted knowledge and attitudes, but they are still limited regarding the communication process among college students (Hamidah et al., 2024; Aripin et al., 2021). Through such communication, students can convey scientific information in a relevant and understandable manner to the audience. The utilization of technology is one of the main drivers in the transformation of learning that allows for

Online ISSN 2655-2450 | Print ISSN 2655-2388

improving communication skills. Learning modification is done by interacting with a CSP-based digital encyclopedia of mammals to develop students' oral communication skills.

A gap analysis was conducted focusing on the differences between students' current and desired oral communication skills, particularly in learning with the CSP-based digital encyclopedia of mammals. The observation results show that students are still less active in group discussions and tend to rely on other members to complete tasks. This creates a gap in the expected communication skills, namely active participation and clear and effective communication. Therefore, learning modification through the utilization of a CSP-based digital encyclopedia of mammals is expected to increase activeness in group discussions and can encourage students to contribute to data collection. In addition, CSP activities themselves have the potential to improve oral communication skills because they provide opportunities for students to be directly involved in research activities so that each member can participate in solving a problem at hand (Roche et al., 2020). The objectives of this study are tailored to the need to improve students' oral communication skills. They are technology-based, which will contribute to the development of more effective and relevant learning.

2. Method

This study uses a quantitative descriptive method to obtain an overview of students' oral communication skills through observation. The research sample was 30 students who took the vertebrate zoology course. The data collection technique used was observation. The instrument used was a validated student oral communication skills observation sheet. The data analysis technique used is a quantitative description analysis technique.

The research indicators were developed by Widanski *et al*., (2020), Oktasari *et al*., (2019), dan Mercer-Mapstone & Matthews (2017) communication skills indicators according to the research needs. Indicators of oral communication skills consist of 7 indicators, namely being able to provide information or ideas, mastering the material to be used as presentation material, delivering report results systematically and asking skills, being able to answer questions, being confident, and being active in group discussions can be seen in Table 1.

Table 1. Indicators of Oral Communication

Indicator	Score	
Able to provide information or ideas	4	Every group member is able to provide information or ideas
	3	Most group members are able to provide information or ideas Half of the group members are able to provide information or ideas
	2	A small number of group members are able to provide information or ideas
	1	
Mastering the material that will be used as presentation material	4	Each group member is able to express opinions and accept the opinions of others and master the material
	3	Most group members are able to express opinions and accept other people's opinions and master the material.
	2	Half of the group members are able to express opinions and accept other people's opinions and master the material.
	1	A small number of group members are able to express opinions and accept other people's opinions and master the material.
Deliver report results systematically and clearly	4	Each group member explains the results of his/her report sequentially using tables and pictures.
	3	Each group member explains the results of his/her report sequentially using tables or pictures.
	2	Each group member explains the results of his/her report out of order using tables or pictures.
	1	Each group member explains the results of his/her report out of order without using tables and pictures.
Questioning skills	4	More than 5 questions are asked and all questions can be answered
	3	Asked 5 questions and 4 questions were answered
	2	Asked 5 questions and 3 questions were answered
	1	Less than 5 questions asked and less than 3 questions answered
Able to answer questions	4	More than 5 questions are asked and all questions can be answered
	3	Asked 5 questions and 4 questions were answered
	2	Asked 5 questions and 3 questions were answered
	1	Less than 5 questions asked and less than 3 questions answered
Confident	4	Every group member dares to argue without hesitation, ask and answer questions
	3	

Online ISSN 2655-2450 | Print ISSN 2655-2388

	2	Most of the group members dare to argue, ask and answer questions.
	1	Half of the group members dare to argue, ask and answer questions. A small number of group members did not dare to argue, ask and answer questions.
Active in group discussion	4	Every group member is active in the discussion
	3	Most of the group is active in the discussion
	2	Half of the group members are active in the discussion
	1	A small number of group members are active in the discussion

Guidelines for assessing indicators of students' oral communication skills can be seen in Table 2.

Table 2. Achievement Level Categories Mean score

Percentage Range	Categori
86 -100%	very good
71 – 85%	good
56 – 70%	sufficient
41 – 55%	needs improvement
25 - 40%	insufficient

3. Result and Discussion

Oral communication skills in students are very important and have been emphasized from the initial stage to the final stage of the learning process. Communication skills as one of the 21st-century skills in the 4C skills framework (Maryuningsih *et al.*, 2020). The design of the relationship between research variables can be seen in Figure 1.

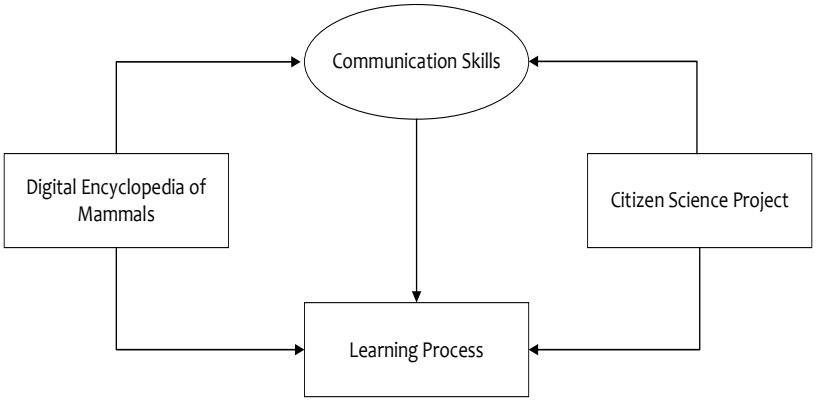

Figure 1. Design of the relationship between research variables

Communication skills can be improved through practical experience by using a CSP-based digital encyclopedia of mammals that directly supports the learning process. Students can interact, share ideas, and present learning outcomes. The digital encyclopedia of mammals provides information and supports students in developing insights about mammals. CSP involves students directly in data collection and reporting, which can strengthen communication skills.

The results showed data on group oral communication skills based on observations during each group's presentation in class, which were analyzed for each indicator. The assessment of oral communication skills was conducted through peer assessment, in which each group evaluated the other group. This process involved five groups, each evaluating the other group's presentation based on the predetermined indicators of oral communication skills. Peer assessment in group presentations provides an opportunity for students to evaluate each other's performance based on an assessment rubric. The evaluation given by peers can help identify the shortcomings of the presentation and can motivate them to make improvements (Double *et al.*, 2019; Li *et al.*, 2019; Murillo-zamorano & Montanero, 2017). The observation data of oral communication skills can be seen in Table 3.

Online ISSN 2655-2450 | Print ISSN 2655-2388

Table 3. Observation Data of Oral Communication Skills of Each Group

No	Indicator	Score																				%	Interpretation Data
		Group 1				Group 2				Group 3				Group 4				Group 5					
		2	3	4	5	1	3	4	5	1	2	4	5	1	2	3	5	1	2	3	4		
1	Able to provide information or ideas	3	3	3	2	4	3	3	3	3	3	3	3	3	3	4	3	3	2	3	3	75	Good
2	Mastering the material that will be used as presentation material	3	3	2	3	3	2	3	3	3	3	3	2	3	2	3	3	4	3	2	3	70	Sufficient
3	Deliver report results systematically and clearly	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	4	3	3	3	75	Good
4	Questioning skills	2	3	2	3	2	3	3	3	2	3	3	4	3	3	3	2	2	4	3	3	70	Sufficient
5	Able to answer questions	2	3	4	3	3	3	3	3	2	3	3	4	3	3	3	3	3	3	3	3	75	Good
6	Confident	2	2	3	3	2	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	70	Sufficient
7	Active in group discussion	4	4	3	4	4	4	3	4	4	4	4	3	4	4	3	4	4	4	4	4	90	Very Good

The observation results in Table 3 show that the assessment category on the indicator of mastering the material to be used as presentation material, the indicator of questioning skills and confidence is included in the sufficient category. Indicators of providing information or ideas, delivering report results systematically and clearly, and indicators of being able to answer questions fall into the good category. The 7th indicator, active in group discussions, is in the very good category. Figure 2 shows the distribution of student communication skills assessment consisting of sufficient, good, and very good categories.

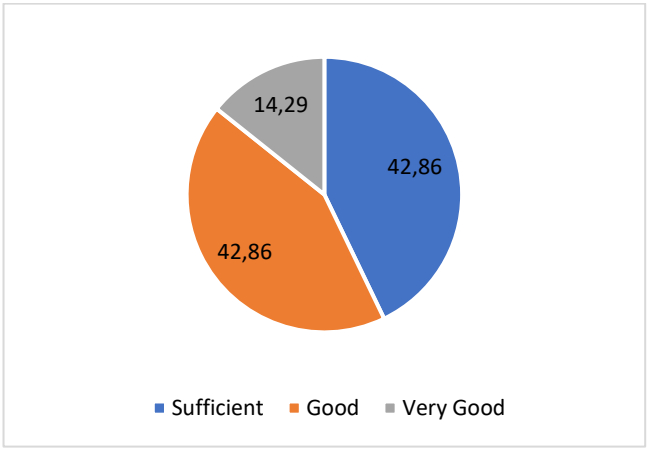

Figure 2. Distribution of Student Oral Communication Skills Assessment

Humans naturally need interaction and communication to fulfill the need to build relationships and convey ideas and information. Communication is a bridge to develop mutual understanding and achieve common goals (Thoma *et al.*, 2019). Communication skills are essential in using a CSP-based digital encyclopedia of mammals because its implementation requires students to communicate clearly and effectively with each group member. In the context of CSP, communication skills allow students as citizen scientists to convey observation data and explain information to various parties involved. The results of the average percentage value of each indicator of oral communication skills can be seen in Figure 3.

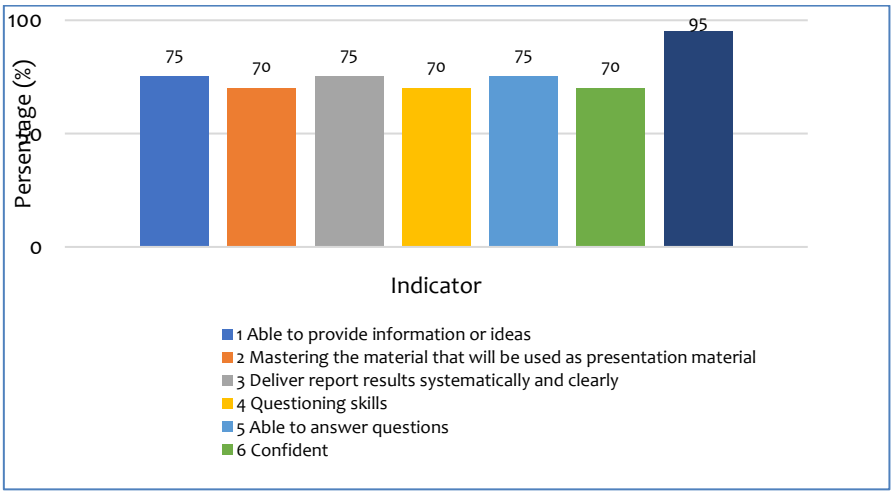

Figure 3. Percentage of Each Oral Communication Skills Indicator

Online ISSN 2655-2450 | Print ISSN 2655-2388

Students can provide information through group presentations because this activity allows them to convey ideas, observations, or data that have been collected in a structured and clear manner. In group presentations, students work together to prepare materials, divide tasks, and determine effective strategies for delivering information. This activity also trains them to organize information based on a logical sequence so that the audience quickly understands it. In addition, group presentations provide space for students to improve their verbal and nonverbal communication skills, such as voice intonation, eye contact, and supportive body language.With clear assessment guidelines or rubrics, students can understand the standards to be achieved, encouraging them to prepare better. Interaction with the audience during the Q&A session also helps them strengthen their understanding of the material and build confidence in conveying information. Therefore, group presentations are an effective means for students to hone their communication skills and share knowledge collaboratively.

The first indicator of communication skills is providing information or ideas, indicating that each group can provide information in presentation activities. However, the depth of information will differ between one group and another. The average value of students' ability to provide information or ideas is 75%. Presentation activities require students to deliver material that has been prepared in advance. Each group prepares the material by dividing tasks among group members, including searching for data, compiling presentation materials, and practicing delivering the material so that the information delivered has been studied and understood previously. Group discussions are meaningful because they allow students to interact with each other to understand the material so that they can provide information (Abdulbaki *et al*., 2018).

Communication skills play an important role in academic activities because they help students present the results of group discussions so that shared understanding and collaboration can be achieved when each individual can express their views and receive input from each group. Group presentation activities can be seen in Figure 4.

Figure 4. Group Presentation

The series of CSP activities involved students in FGD activities, which is a process of collecting data and information through group discussions. Students are trained to deliver information on the topics discussed, with the aim of explaining them to the audience (Yulianti & Sulistyawati, 2021). FGD can increase academic motivation because they present different learning and encourage students to be actively involved in learning (Hidajat *et al*., 2020). Group discussion activities that have been carried out can train students to express opinions with their knowledge based on data or facts so that they can share information on the topic of mammals and their extinction issues. All student groups conducted discussions with resource persons, including veterinarians and conservation teams, regarding the existence of mammals and expressed problems regarding the extinction of several mammal species. Through group discussion activities, students can convey information and develop critical and innovative thinking skills in finding solutions to various problems faced.

The percentage of the second indicator, namely mastering the material that will be used as presentation material, is 70%. The materials to be presented must be prepared by each group of students equipped with various learning resources, such as utilizing the surrounding environment and technology services. Students can use the environment to observe mammal species directly and obtain information by observing the morphological characteristics of the species. Meanwhile, data on the role of mammals, distribution, and conservation status can be supplemented from various other sources. In addition, along with the development of the technological era, students can utilize multiple technological devices to find and access the

Online ISSN 2655-2450 | Print ISSN 2655-2388

necessary information (Nurfadillah & Ardiansah, 2021; Pratiwi *et al*., 2019). Data obtained from various sources can increase students' knowledge and help them systematically and clearly convey the results of field observations. In line with the research of Moussa & Mohan (2024), it is stated that using technology in citizen science (CS) projects has increased the effectiveness of animal monitoring, enabled data collection, and encouraged people to get involved in activities. Research by Williams *et al*. (2017) explained that technology integration in learning can provide opportunities to increase engagement, build independence, and encourage collaboration. In addition, using technology opens up opportunities to become active researchers who connect classroom learning with the field.

The percentage on the third indicator, namely submitting report results systematically and clearly, was 75%. Each group of students follows the guidelines presented by the lecturer to submit the results of the observation report systematically and by applicable academic standards. In addition to making identification, students are also expected to be able to compile observation reports in a structured manner, complete with relevant references to support the quality of the report (Laia, 2023; Ridwan *et al*., 2021; Zurell *et al*., 2020).

The fourth communication skills indicator is the questioning skills every student needs. (Kurniawati *et al*., 2021). These skills help students fulfill their curiosity and encourage active participation in the learning process (Waruwu *et al*., 2023). Based on the observation results, students' achievement of questioning skills reached 70%. To support this, each group member is expected to actively ask relevant questions, such as those related to mammal extinction, to encourage discussion activities and to develop critical thinking skills in finding solutions to these problems. In addition, questions asked by students can play a role in creating an interactive and collaborative classroom atmosphere where students can share ideas with each other (Ramadani *et al*., 2023). Thus, questioning skills become one of the important elements in building a dynamic learning environment.

The percentage value on the fifth indicator, namely the ability to answer questions, is 75%. This achievement is associated with the role of the CSP-based digital encyclopedia of mammals designed to involve students in the learning process actively. At the CSP stage, students are users, collectors, and presenters of scientific information. When using the encyclopedia, students are invited to understand information, compile data-based answers, and present answers. This

situation creates a supportive learning environment where students can practice answering questions. The CSP-based digital encyclopedia can be used as a reference that provides easily accessible and relevant information. In group discussions, students often refer to the data available in the encyclopedia to strengthen their arguments. The use of this encyclopedia also motivates students to explore answers to questions, both through these digital resources and from other relevant literature. This enriches students' insights and improves their ability to formulate answers appropriately. In addition, involvement in learning can motivate students to be more active in finding answers to questions, both through group discussions and by utilizing other reference sources that can improve their ability to answer questions (Hasanah & Himami, 2021).

The sixth indicator of communication skills is self-confidence, an important element every student owns. The level of self-confidence will vary for each individual, whereas students with high self-confidence usually have confidence in their abilities. Based on the observation results, the percentage value of communication skills on the self-confidence indicator is 70%. This can be caused by students being directly involved in activities such as interaction with the community and the use of digital technology. The involvement of these students provides practical experience in communicating, solving problems faced, and honing students' abilities in real terms. This experience can increase self-confidence because students are directly involved in carrying out and participating in learning activities. In addition, students with confidence tend to be more initiative and ask many questions in learning activities (Hong *et al*., 2021). Although the percentage achieved has not been maximized, various activities that have been carried out, such as making direct observations, a supportive environment, and utilization of technology, have contributed to gradually increasing students' self-confidence.

The seventh indicator is active in group discussions, with a percentage value included in the excellent category of 95%. These scores fall into the excellent category. Most students managed to show an exceptional level of participation and activeness. Student engagement in the learning process is essential as it shows that students are not only physically present in the discussion but also take an active part in the interaction and exchange of ideas, which contributes to the development of their oral communication skills. This is in line with several studies that explain that

Online ISSN 2655-2450 | Print ISSN 2655-2388

through group discussions, learning becomes more interactive and can increase student confidence, allow students to think critically, and improve collaboration skills (Crisianita & Mandasari, 2022).

Group discussions are conducted so that students gain an in-depth understanding of the issues discussed and obtain data from a group of deliberately selected individuals (Nyumba *et al*., 2018). The implementation of group discussions is carried out by observing the predetermined provisions to ensure the process runs smoothly and allows each member to express their opinions in a conducive atmosphere (Sim & Waterfield, 2019; Erlangga, 2018). The applied method can encourage students to work in teams and actively participate in every stage of learning, from planning and socialization to program implementation. Group discussions also involve the use of technology, which makes learning more dynamic and interesting. The interactivity encourages students to participate more in group discussions because students are emotionally and intellectually involved in the learning process. In addition, the assignments often require critical and creative thinking, so students will be more encouraged to discuss actively and share ideas with their group members to find solutions (Novitasary, 2023; Lombardi *et al*., 2021; Driessen *et al*., 2020).

4. Conclusion

Based on the study's results, using CSP-based mammal digital encyclopedias can encourage the development of students' oral communication skills. The average percentage value on the indicator of mastering the material that will be used as presentation material is 70%, including the sufficient category; questioning skills of 70%, including the sufficient category; and self-confidence of 70%, including the sufficient category. In addition, the indicator of providing information or ideas was 75% in the good category, delivering the results of the report systematically was 75% in the good category, and being able to answer questions was 75% in the good category. Indicators included in the very good indicator are active in group discussions with a value of 95%.

The designed learning facilitates students' active participation and improves oral communication skills. Intensive group discussions, directed guidance, and assignments that demand critical thinking contribute to increased student participation in the teaching and learning process. With good communication skills,

information dissemination not only takes place efficiently but also creates a deeper understanding that will support the achievement of scientific goals through valid data collection.

References

Abdulbaki, K., Suhaimi, M., Alsaqqaf, A., & Jawad, W. (2018). The Use of the Discussion Method at University : Enhancement of Teaching and Learning. *International Journal of Higher Education*, *7*(6), 118–128. https://doi.org/10.5430/ijhe.v7n6p118

Aripin, I., Hidayat, T., & Rustaman, N. (2021). Knowledge , Attitudes , and Behavior of Prospective Biology Teachers towards Biodiversity Conservation in Indonesia Knowledge , Attitudes , and Behavior of Prospective Biology Teachers towards Biodiversity Conservation in Indonesia. *European Online Journal of Natural and Social Sciences*, *10*(3), 456–462.

Colovic, A., Caloffi, A., Rossi, F., Paladini, S., & Bagherzadeh, M. (2024). Innovation Intermediaries and Emerging Digital Technologies. *Technovation*, *133*. https://doi.org/https://doi.org/10.1016/j.technovation.2024.103022

Crisianita, S., & Mandasari, B. (2022). The Use of Small-Group Discussion To Improve Student' Speaking Skill. *Journal of Research on Language Education (JoRLe)*, *3*(1), 61–66.

Double, K. S., Mcgrane, J. A., & Hopfenbeck, T. N. (2019). The Impact of Peer Assessment on Academic Performance : A Meta-analysis of Control Group Studies. *Educational Psychology Review*.

Driessen, E. P., Knight, J. K., Smith, M. K., & Ballen, C. J. (2020). Demystifying the meaning of active learning in postsecondary biology education. *CBE Life Sciences Education*, *19*(4), 1–9. https://doi.org/10.1187/cbe.20-04-0068

Erlangga, E. (2018). *Bimbingan Kelompok Meningkatkan Keterampilan Berkomunikasi Siswa*. *4*, 149–156. https://doi.org/10.15575/psy.v4i1.1332

Online ISSN 2655-2450 | Print ISSN 2655-2388

Hamidah, N., Hidayat, T., Sriyati, S., & Gusti, U. A. (2024). How Students Communicate in Citizen Science Project to Build Knowledge. *Jurnal Pendidikan MIPA*, 25(1), 1–13. https://doi.org/http://dx.doi.org/10.23960/jpmipa/v25i1.pp1-13

Haryanti, A., & Suwarma, I. R. (2018). Profil Keterampilan Komunikasi Siswa SMP Dalam Pembelajaran Berbasis STEM. *Jurnal Wahana Pendidikan Fisika*, *3*(1), 49–54.

Hasanah, Z., & Himami, A. S. (2021). Model Pembelajaran Kooperatif Dalam Menumbuhkan Keaktifan Belajar Siswa. In *Irsyaduna: Jurnal Studi Kemahasiswaaan* (Vol. 1, Issue 1, pp. 1–13). https://doi.org/10.54437/irsyaduna.v1i1.236

Hidajat, H. G., Hanurawan, F., Chusniyah, T., & Rahmawati, H. (2020). Why i'm bored in learning? Exploration of students' academic motivation. *International Journal of Instruction*, *13*(3), 119–136. https://doi.org/10.29333/iji.2020.1339a

Hong, J. C., Hsiao, H. S., Chen, P. H., Lu, C. C., Tai, K. H., & Tsai, C. R. (2021). Critical attitude and ability associated with students' self-confidence and attitude toward "predict-observe-explain" online science inquiry learning. *Computers and Education*, *166*(104172). https://doi.org/10.1016/j.compedu.2021.104172

Jayawardana, H. B. A., & Gita, R. (2020). Inovasi Pembelajaran Biologi di Era Revolusi Industri 4.0. *Prosiding Seminar Nasional Biologi Di Era Pandemi COVID-19 Gowa*, *September*, 58–66. http://journal.uin-alauddin.ac.id/index.php/psb/

Kurniawati, Z. L., Nasution, R., Jailani, J., & Bardin, S. (2021). Students' Questioning Skills in Environmental Pollution Course Using Case Study Methods. *ScienceEdu: Jurnal Pendidikan IPA*, *4*(1), 46. https://doi.org/10.19184/se.v4i1.23947

Laia, E. (2023). Analisis Struktur Teks Laporan Observasi Siswa Kelas X Sma Negeri 2 Susua Tahun Pelajaran 2021/2022. *KOHESI : Jurnal Pendidikan Bahasa Dan Sastra Indonesia*, *3*(2), 13–23. https://doi.org/10.57094/kohesi.v3i2.848

Latif, R., Mumtaz, S., Mumtaz, R., & Hussain, A. (2018). A comparison of debate and role play in enhancing critical thinking and communication skills of medical students during problem based learning. *Biochemistry and Molecular Biology Education*, *46*(4), 336–342. https://doi.org/10.1002/bmb.21124

Li, H., Xiong, Y., Hunter, C. V., Guo, X., & Tywoniw, R. (2019). Does peer assessment promote student learning ? A meta-analysis. *Assessment & Evaluation in Higher Education*, *2938*, 1–20. https://doi.org/10.1080/02602938.2019.1620679

Lombardi, D., Shipley, T. F., Bailey, J. M., Bretones, P. S., Prather, E. E., Ballen, C. J., Knight, J. K., Smith, M. K., Stowe, R. L., Cooper, M. M., Prince, M., Atit, K., Uttal, D. H., LaDue, N. D., McNeal, P. M., Ryker, K., St. John, K., van der Hoeven Kraft, K. J., & Docktor, J. L. (2021). The Curious Construct of Active Learning. *Psychological Science in the Public Interest*, 22(1), 8–43. https://doi.org/10.1177/1529100620973974

Malik, R. S. (2018). Educational Challenges In 21 St Century And Sustainable Development. *Journal of Sustainable Development Education and Research*, 2(1), 9–20.

Maryuningsih, Y., Hidayat, T., Riandi, & Rustaman, N. (2020). Developing Performance Assessment Instruments to Measure 4C Skills in Online Discussion Activities of Science Learning. *Scientiae Educatio: Jurnal Pendidikan Sains*, 9(1), 109–120. https://doi.org/http://dx.doi.org/10.24235/sc.educatia.v9i1.7500

Mercer-Mapstone, L. D., & Matthews, K. E. (2017). Student perceptions of communication skills in undergraduate science at an Australian research-intensive university. *Assessment and Evaluation in Higher Education*, 42(1), 98–114. https://doi.org/10.1080/02602938.2015.1084492

Moussa, L. G., & Mohan, M. (2024). Exploring Citizen Science Applications for Wildlife Monitoring. *Premier Journal of Environmental Science*, *1*(100005), 1–7. https://doi.org/https://doi.org/10.70389/ PJES.100005

Murillo-zamorano, L. R., & Montanero, M. (2017). Oral presentations in higher education : a comparison of the impact of peer and teacher feedback. *Assessment & Evaluation in Higher Education*, 43(1), 138–150. https://doi.org/10.1080/02602938.2017.1303032

National Education Association. (2024). *Preparing 21st Century Students for a Global Society An Educator's Guide to the " Four Cs " able of Contents*.

Online ISSN 2655-2450 | Print ISSN 2655-2388

Novitasary, R. R. (2023). Penerapan Pembelajaran Berbasis Proyek pada Kurikulum Merdeka Belajar untuk Meningkatkan Keterampilan Komunikasi Peserta Didik. *Jurnal Inovasi Pembelajaran Biologi*, *4*(2), 100–112. https://doi.org/10.26740/jipb.v4n2.p100-112

Nurfadillah, M., & Ardiansah. (2021). Perilaku Pencarian Informasi Mahasiswa Dalam Memenuhi Kebutuhan Informasi Sebelum Dan Saat Pandemi Covid-19. *Jurnal Ilmu Perpustakaan Dan Informasi*, *16*(1), 21–39.

Nyumba, T. O., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). *The use of focus group discussion methodology : Insights from two decades of application in conservation*. *2018*(July 2017), 20–32. https://doi.org/10.1111/2041-210X.12860

Oktasari, D., Jumadi, Warsono, Hariadi, M. H., & Syari, E. L. (2019). 3D Page-Flipped Worksheet on Impulse-Momentum To Develop Students' Scientific Communication Skills. *Jurnal Pendidikan IPA Indonesia*, *8*(2), 211–219. https://doi.org/10.15294/jpii.v8i2.15737

Prabavathi, R., & Nagasubramani, P. C. (2018). Effective oral and written communication. *Journal of Applied and Advanced Research*, *3*, 29–32. https://doi.org/https://dx.doi.org/10.21839/jaar.2018.v3S1.164

Pratiwi, B., Nur Ali, R., & Sulistiyowati, E. (2019). Pengembangan Media Pembelajaran Biodiversitas Berbasis Android. *Journal of Tropical Chemistry Research & Education (JTC-RE)*, *1*(1), 36–42. https://doi.org/10.57084/jeda.v1i1.965

Rahimova, I. (2024). Innovative Strategies For Improving Oral Communication Skills In Elf. *Practical Problem and Solutions to the Use of Theoretical Laws in the Sciences of the 21th Century (PPSUTLSC-2024)*, *4*(7), 326–328.

Ramadani, P. W., Wahyuningtyas, L. P., Bachtiar, M. T., & Damariswara, R. (2023). Analisis Keterampilan Bertanya Mahasiswa Saat Presentasi Dalam Kelas. *AKSARA: Jurnal Ilmu Pendidikan Nonformal*, *9*(3), 1569–1576.

Ratheeswari, K. (2018). Information Communication Technology in Education. *Journal of Applied and Advanced Research*, *3*, 45–47. https://doi.org/https://dx.doi.org/10.21839/jaar.2018.v3S1.169

Reith-Hall, E., & Montgomery, P. (2022). The Teaching and Learning of Communication Skills in Social Work Education. *Research on Social Work Practice*, *32*(7), 793–813. https://doi.org/10.1177/10497315221088285

Ridwan, M., AM, S., Ulum, B., & Muhammad, F. (2021). Pentingnya Penerapan Literature Review pada Penelitian Ilmiah. *Jurnal Masohi*, *02*(01), 42–51.

Roche, J., Bell, L., Galvão, C., Golumbic, Y. N., Kloetzer, L., Knoben, N., Laakso, M., Lorke, J., Mannion, G., Massetti, L., Mauchline, A., Pata, K., Ruck, A., Taraba, P., & Winter, S. (2020). Citizen Science, Education, and Learning: Challenges and Opportunities. *Frontiers in Sociology*, *5*(December), 1–10. https://doi.org/10.3389/fsoc.2020.613814

Sim, J., & Waterfield, J. (2019). Focus group methodology : some ethical challenges. *Quality & Quantity*, *53*(6), 3003–3022. https://doi.org/10.1007/s11135-019-00914-5

Suhanti, I. Y., Puspitasari, D. N., & Noorrizki, R. D. (2018). Keterampilan Komunikasi Interpersonal Mahasiswa UM. *Prosiding Seminar Nasional Psikologis Klinis: Perkembangan Masyarakat Indonesia Terkini Berdasarkan Pendekatan Biopsikososial*, *26 Agustus 2018*, 80–88.

Susbiyanto, S., Hidayat, T., Surtikanti, H. K., & Riandi, R. (2024). Citizen Science Project Design for Ecology Course: Reducing Pollution Caused By Gold Mining. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *8*(1), 117–135. https://doi.org/10.22437/jiituj.v8i1.32348

Thoma, B., Turnquist, A., Zaver, F., Hall, A. K., & Chan, T. M. (2019). Communication , learning and assessment : Exploring the dimensions of the digital learning environment. *Medical Teacher*, 1–7. https://doi.org/10.1080/0142159X.2019.1567911

Trilling, B., & Fadel, C. (2009). 21st Century Skills_ Learning for Life in Our Times. In *Journal of Sustainable Development Education and Research* (Vol. 2, Issue 1).

Waruwu, A. N., Rahmadhanty, A., Hutagalung, A., Sari, I. P., & Almsy, Z. (2023). Keterampilan Bertanya dalam Proses Pembelajaran di Kelas. *Paedagogi: Jurnal Kajian Ilmu Pendidikan (e-Journal)*, *9*(1), 65. https://doi.org/10.24114/paedagogi.v9i1.44757

Online ISSN 2655-2450 | Print ISSN 2655-2388

Widanski, B., Thompson, J. A., & Foran-Mulcahy, K. (2020). Improving Students' Oral Scientific Communication Skills through Targeted Instruction in Organic Chemistry Lab. *Journal of Chemical Education*, 97(10), 3603–3608. https://doi.org/10.1021/acs.jchemed.9b01190

Williams, P. J., Nguyen, N., & Mangan, J. (2017). Using technology to support science inquiry learning. *Journal of Technology and Science Education*, 7(1), 1–16.

Yulianti, T., & Sulistyawati, A. (2021). Enhancing Public Speaking Ability Through Focus Group Discussion. *Jurnal PAJAR (Pendidikan Dan Pengajaran)*, 5, 519–525.

Zurell, D., Franklin, J., König, C., Bouchet, P. J., Dormann, C. F., Elith, J., Fandos, G., Feng, X., Guillera-Arroita, G., Guisan, A., Lahoz-Monfort, J. J., Leitão, P. J., Park, D. S., Peterson, A. T., Rapacciuolo, G., Schmatz, D. R., Schröder, B., Serra-Diaz, J. M., Thuiller, W., … Merow, C. (2020). A standard protocol for reporting species distribution models. *Ecography*, 43(9), 1261–1277. https://doi.org/10.1111/ecog.04960