JPPIPA 9(11) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

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

Student Perceptions of the Implementation of the Concept of Organizer Teacher and Freedom in Learning in Earth and Space Science (ESS) Lectures

Ahmad Farhan[1*], Elisa[1], Fitria Herliana[1], Sri Wahyuni[1], Evita Kharisma[2]

[1] Department of Physics Education, Syiah Kuala University, Darussalam, Banda Aceh, Indonesia.
[2] Student of Physics Education, Syiah Kuala University, Darussalam, Banda Aceh, Indonesia.

Received: September 18, 2023
Revised: October 9, 2023
Accepted: November 25, 2023
Published: November 30, 2023

Corresponding Author:
Ahmad Farhan
farhan@unsyiah.ac.id

DOI: 10.29303/jppipa.v9i11.5391

Abstract: The research was conducted to collect students' perceptions about lecturers' competence in implementing the course, student activity, and atmosphere of course, students' ability to hold material of learning in earth and space science. The research method used was quasi-experimental. The research was carried out in 2 steps where the first step was the control stage carried out using the discussion method. The next step was the treatment stage carried out using innovative discussion methods. The final step gave students the freedom to ask questions about the material earth and space science that they want to know. Student perceptions were obtained using a questionnaire instrument. The results of data analysis in this study show that the quality of lecturers' abilities in managing lectures is in the good category for the control stage and very good for the treatment stage, the lecture atmosphere is pleasant (control) and very pleasant (treatment), students feel active (control), and very active (treatment) in lectures, students' ability to hold a lot of course material (control) and very much (treatment). It was concluded that the innovative discussion method in earth and space science course was able to improve the quality of the lecture process.

Keywords: Atmosphere of course; Student ability; Students' perceptions

Introduction

In efforts to prepare students to face changes, social, cultural, the world of work and technological advances in the 4.0 era, student competencies are prepared according to the needs of the times. Link and match not only with the world of industry and the world of work but also with a rapidly changing future. Universities have been expected to design and implement the learning that includes knowledge, skills, and skills optimally as well as relevant to the times. Therefore, innovations in the learning process are needed, both in terms of media and models or methods (Nulhakim et al., 2020; Setiawan et al., 2023). The Freedom of Learning Policy is expected to be the answer to the development of the era which is increasingly developing and giving birth to Indonesian people who are experts and independent in their respective fields (Kompasnia, 2019; Setiawan et al., 2023). An independent campus is a form of learning in higher education that is autonomous and flexible to create a learning culture that is innovative, unfettered, and following the developments and needs of the times (Mauizdati, 2020; Pakpahan et al., 2023; Yamin & Syahrir, 2020).

The implementation of the concept of driving teacher which is discoursed as the idea of "Freedom of Learning" is a pragmatic hypothetical concept to authorize independence in designing (independent learning) and carrying out an independent learning process that is controlled (autonomous learning) by utilizing one's own potential following the means and available infrastructure and also self-directed learning (Alawi et al., 2022; Apriliyani et al., 2022). The implementation of the concept of "Active Teacher" can

How to Cite:
Farhan, A., Elisa, Herliana, F., Wahyuni, S., & Kharisma, E. (2023). Student Perceptions of the Implementation of the Concept of Organizer Teacher and Freedom in Learning in Earth and Space Science (ESS) Lectures. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 9346–9352. https://doi.org/10.29303/jppipa.v9i11.5391

be done by making small changes and optimizing the existing infrastructure, facilities, and potential in carrying out their duties, without waiting for instructions (Marjan Fuadi, 2022; Prodjo, 2019). Lecturers, according to their scope of authority, can implement the concept of "moving teacher" as part of the "Independent Learning" policy to improve the learning process in their classrooms (Baharuddin, 2021; Mariati, 2021; Zulfiani et al., 2009). The implementation of this concept makes it possible to update or adjust the learning process, both related to models, methods, and other learning aspects according to the available potential (Prawitasari & Suharto, 2020; Yamin & Syahrir, 2020).

Based on this understanding, in the Earth and Space Sciences (ESS) lecture, the course lecturer makes small changes to the discussion method. The innovation of the discussion method is done by giving students the freedom to ask questions and discuss them. The topic of discussion is determined by the students. Lecturers do not limit students to asking about anything they want to know from the latest developments related to the scope of ESS material (Farhan, 2019; Fauziah et al., 2021; Zulfiani et al., 2009). Lecturers only act as facilitators to condition learning with high diversity (authentic and challenging tasks) (Putri et al., 2023; Yuliati et al., 2021).

It is hoped that the broad freedom given can create a sense of independence for students to take control of the knowledge they want to learn, so that sovereign and responsible characters are formed. The lecture process can take place more centered on students-centered learning (Doyan et al., 2017; Pakpahan et al., 2023). This modification provides a freedom that opens up opportunities for all students to play an active role in the learning process, so that more active interactions are formed between fellow students and between students and lecturers in the learning process (Hardini & Puspitasari, 2012; Prodjo, 2019). The various concepts and literature that have been presented in this section encourage this research to understand further about students' perceptions of the implementation of the concept of teacher organizers and freedom in learning in Earth and Space Science (ESS) Lectures. Therefore, this research will reveal students' perceptions about the ability of lecturers to manage lectures, student activity, the learning atmosphere, and students' ability to absorb lecture material. The results of the research are used as input for evaluation and improvement of the lecture process for the next academic year.

Method

The research method used was quasi-experimental. The population of this study was all students who took ESS courses in the fall semester of the 2019/2020 academic year at the Physics Education Department, FKIP, Syiah Kuala University (USK). The population is student stand in three different classes so that the sample determination was carried out by random selection as the research class. A total of 22 students in the research class were used as respondents. Because randomization was carried out in sample groups (classes), the sample for this study was obtained through imperfect randomization. The research was carried out in two steps where the first step was the control stage carried out using the discussion method. The next step was the treatment stage carried out using innovative discussion methods. The final step gave students the freedom to ask questions about the materials earth and space science that they want to know.

The research data is in the form of student perceptions obtained through student response questionnaires. These questions are structured in the form of positive questions. This response questionnaire uses a Likert scale with 4 scores where the score for the statement strongly agree is 4 in descending order until the lowest statement, namely strongly disagree, has a score of 1. The scores obtained from each student's questionnaire answers are calculated as an average. Based on the average score, the qualitative criteria for each student are stated for each aspect of the research, guided by Table 1 (Wahyuddin & Nurcahaya, 2019).

Table 1. Qualitative Criteria for Analysis of Research Data Score

Interval	Criteria
3.50 ≤ score < 4.50	Very Good
2.50 ≤ score < 3.50	Good
1.50 ≤ score < 2.50	Quite Good
1.00 ≤ score < 1.50	Not Good

Result and Discussion

Research data is the perception of students who are respondents to this study. The average score for each aspect of the study was calculated and the qualitative criteria determined, guided by Table 1. Student perceptions and criteria for each aspect of the study are listed in Table 2, Table 3, Table 4, and Table 5.

Table 2 student perceptions of the ability of lecturers in managing lectures. Judging from the average score of student perceptions, improving the quality of lecturers' abilities in lectures. The quality of ability increased from good criteria in lectures with discussion methods to very good in lectures with innovative discussion methods. The increase in student perceptions of the quality of lecturers in carrying out lectures is due to their independence in expressing and discussing problems they want to know (Jufri et al.,

2019). They become more responsible, and independent and share information to discuss the problems they raise themselves (Sumiati, 2009).

Table 2. The Average Score of Student Perceptions and Their Qualitative Criteria on the Ability of Lecturers to Manage Lectures Using Discussion Methods (Control) and Innovative Discussion Methods (Treatment)

Respondent to	Control method	Criteria	Treatment method	Criteria
1	3.82	Very good	4.00	Very good
2	3.27	Good	3.55	Very good
3	3.09	Good	3.55	Very good
4	3.27	Good	3.82	Very good
5	3.27	Good	4.00	Very good
6	3.36	Good	4.00	Very good
7	3.45	Good	4.00	Very good
8	3.55	Very good	4.00	Very good
9	3.64	Very good	4.00	Very good
10	3.36	Good	3.91	Very good
11	3.55	Very good	4.00	Very good
12	3.73	Very good	3.91	Very good
13	3.36	Good	4.00	Very good
14	3.36	Good	3.91	Very good
15	3.45	Good	4.00	Very good
16	3.55	Very good	4.00	Very good
17	3.27	Good	3.55	Very good
18	3.45	Good	4.00	Very good
19	3.36	Good	3.64	Very good
20	3.27	Good	3.82	Very good
21	3.36	Good	4.00	Very good
22	3.64	Very good	4.00	Very good
Average	3.43	Good	3.89	Very good

Figure 1. Percentage of students' perceptions of the quality of lecturers' abilities in managing lectures on control and experimental methods

Lecturers, as learning facilitators, provide reinforcement to the discussion material and/or correct erroneous understandings in the process. This condition gives higher satisfaction to students. The same results were also obtained in lectures with innovative discussion methods in Thermodynamics lectures; it was reported that the ability of lecturers to manage lectures gave better satisfaction to students (Farhan et al., 2021; Hilmi et al., 2017; Yuliana et al., 2021).

Table 3. The Average Score of Student Perceptions and Their Qualitative Criteria for Activity in Lectures with Discussion Methods (Control) and Innovative Discussion Methods (Treatment)

Respondent to	Control method	Criteria	Treatment method	Criteria
1	3.00	Active	3.50	Very active
2	2.50	Active	3.50	Very active
3	2.75	Active	3.25	Active
4	2.75	Active	3.25	Active
5	3.50	Active	4.00	Very active
6	2.75	Active	2.75	Active
7	3.50	Active	4.00	Very active
8	2.75	Active	2.75	Active
9	3.50	Very active	4.00	Very active
10	2.75	Active	3.00	Active
11	3.00	Active	4.00	Very active
12	3.50	Very Active	3.50	Very active
13	2.75	Active	3.75	Very active
14	3.50	Very active	4.00	Very active
15	3.50	Very active	4.00	Very active
16	3.50	Very active	4.00	Very active
17	2.75	Active	3.50	Very active
18	3.50	Very active	4.00	Very active
19	2.25	Active	3.00	Active
20	3.00	Active	3.75	Very active
21	3.50	Very active	4.00	Very active
22	3.00	Active	3.50	Very active
Average	3.07	Active	3.59	Very active

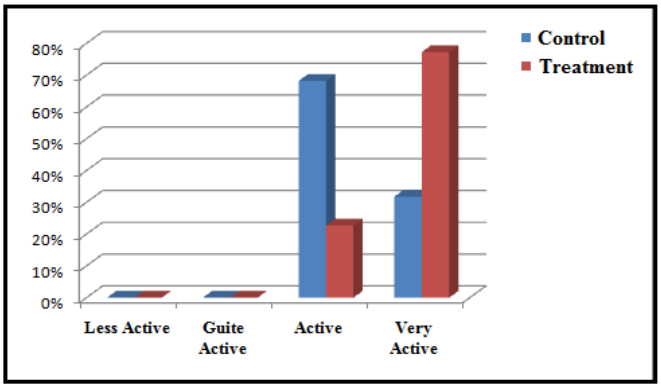

Figure 2. Percentage of students' qualitative perceptions of lecturers' abilities in managing lectures on control and experimental methods

Students' freedom in innovative discussions affects their activity. Scores and qualitative criteria from the aspect of student activity in lectures with control and treatment methods are listed in Table 3. The criteria for student activity increased from the active category in lectures with the discussion method to being very active in lectures with innovative discussion methods.

In lectures using the discussion method, 15 students (68.19%) felt active and 7 students (31.81%) felt very active. Students' perceptions of lectures conducted with innovative discussion methods, 5 students (22.73%) felt active and 17 students (77.27%) were very active (Figure 2). The criteria for student activity in lectures in both discussion methods are relatively high. This is because the discussion method is one of the active learning methods, which is based on the theory of constructivist learning (Farhan et al., 2021; Rajagukguk et al., 2023). Modification of the discussion method causes the learning process to be more student-centered (Akbar, 2017; Widianingtiyas et al., 2015). As a result, student activity in lectures becomes higher.

Table 4. The Average score of Student Perceptions and Qualitative Criteria for Learning Atmosphere in Lectures with Discussion Methods and Innovative Discussion Methods

Respon-dent to	Method control	Criteria	Treatment method	Criteria
1	3.50	Very pleasant	3.83	Very pleasant
2	3.33	Pleasant	3.50	Very pleasant
3	3.50	Very pleasant	3.50	Very pleasant
4	3.50	Very pleasant	3.50	Very pleasant
5	3.17	Very pleasant	4.00	Very pleasant
6	3.50	Very pleasant	3.50	Very pleasant
7	3.50	Very pleasant	4.00	Very pleasant
8	3.50	Very pleasant	4.00	Very pleasant
9	3.33	Pleasant	4.00	Very pleasant
10	3.67	Very pleasant	3.50	Very pleasant
11	3.50	Very pleasant	4.00	Very pleasant
12	3.67	Very pleasant	4.00	Very pleasant
13	3.50	Very pleasant	3.50	Very pleasant
14	3.50	Very pleasant	4.00	Very pleasant
15	3.17	Pleasant	4.00	Very pleasant
16	3.67	Very pleasant	4.00	Very pleasant
17	2.83	Pleasant	3.67	Very pleasant
18	3.50	Very pleasant	4.00	Very pleasant
19	3.33	Pleasant	3.00	Very pleasant
20	3.50	Very pleasant	3.75	Very pleasant
21	3.50	Very pleasant	4.00	Very pleasant
22	3.33	Pleasant	3.50	Very pleasant
Average	3.43	Pleasant	3.59	Very pleasant

Students feel pleasant in a very pleasant atmosphere during the lecture process (Table 4). Based on the average score, there was an increase in the learning atmosphere. Students feel a more pleasant learning atmosphere in lectures with innovative discussion methods, compared to discussion methods. In lectures with the discussion method, 7 students (31.82%) felt the lecture atmosphere was fun and 15 students (68.18%) experienced a very pleasant lecture atmosphere. Only 1 student (4.55%) felt that the lecture atmosphere was pleasant and the remaining 21 students (95.45%) felt that the lecture atmosphere was very pleasant in lectures with innovative discussion methods (Figure 3).

The improvement in the learning atmosphere experienced by students is an indication that the lecturer's ability to manage lectures can increase interest and motivation in learning. A pleasant and very pleasant learning atmosphere will be created if the interest and motivation of students have improved.

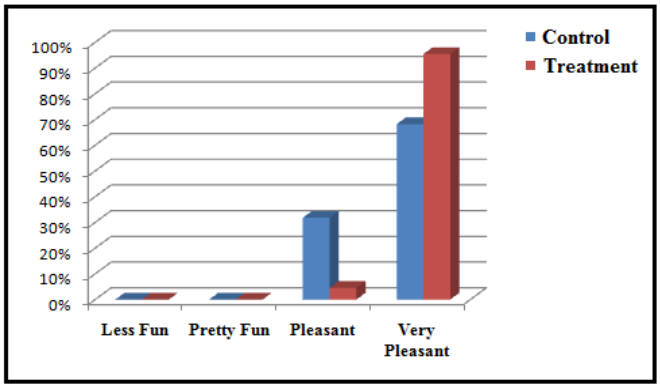

Figure 3. The atmosphere of the lecture was felt by students in the control and experimental methods in percentage

Modification of the discussion method gives students independence in learning. This presents a conducive, calm, comfortable learning atmosphere. Interest and motivation to learn also increase, so that the learning atmosphere becomes better.

Table 5. The Average Score of Student Perceptions and Qualitative Criteria on Aspects of the Ability to Absorb Material in Lectures with Discussion Methods and Innovative Discussion Methods

Respondent to	Method control	Criteria	Method Treatment	Criteria
1	4.00	A huge amount	4.00	A huge amount
2	3.00	Many	3.33	Many
3	3.00	Many	3.33	Many
4	3.00	Many	3.33	Many
5	3.00	Many	4.00	A huge amount
6	4.00	A huge amount	3.33	Many
7	3.00	Many	4.00	A huge amount
8	4.00	A huge amount	4.00	A huge amount
9	3.33	Many	4.00	A huge amount
10	3.00	Many	4.00	A huge amount
11	3.67	A huge amount	4.00	A huge amount
12	3.33	Many	4.00	A huge amount

Respondent to	Method control	Criteria	Method Treatment	Criteria
13	3.00	Many	3.67	A huge amount
14	3.00	Many	4.00	A huge amount
15	3.00	Many	4.00	A huge amount
16	3.33	Many	4.00	A huge amount
17	3.33	Many	3.33	Many
18	3.00	Many	4.00	A huge amount
19	3.00	Many	3.67	A huge amount
20	3.00	Many	4.00	A huge amount
21	3.00	Many	4.00	A huge amount
22	3.67	A huge amount	4.00	A huge amount
Average	3.26	Many	3.82	A huge amount

In the innovative discussion process, students can ask and answer questions to share knowledge with their friends. This affects the absorption of lecture material (Table 5). Innovative discussion lecture methods can increase the ability to absorb lecture material by students from many categories (control) to very many (treatment).

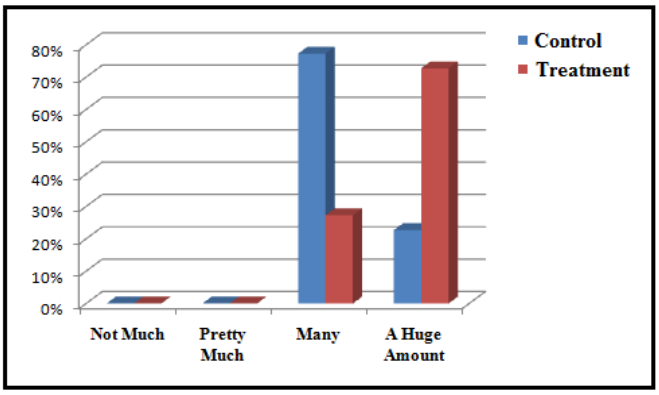

Figure 4. Percentage of students' perceptions of aspects of absorption of lecture material on the control and treatment method.

In lectures using the control method, 17 students (77.27%) felt the ability to absorb lecture material in many criteria. 6 students (22.73%) felt their ability to absorb lecture material in a very large category. In lectures using the treatment method, 5 students (22.73%) perceived that they were able to absorb lecture material in many categories and 16 students (72.73%) were very much (Figure 4).

The absorption of lecture material is the impact of a process in interrelated learning. If the lecturer's ability in lectures is good, the active aspects and learning atmosphere will also be good.

Table 6. Summary of the Average Score of the Questionnaire Answers from the Research Respondents and their Qualification Criteria from the Four Aspects of the Study

Aspect study	Average score of questionnaires and criteria in class			
	Control		Experiment	
	Score	Criteria	Score	Criteria
Lecturer's ability in managing lectures	3.43	Good	3.89	Very good
Student activity in lectures	3.07	Active	3.59	Very active
Lecture atmosphere	3.43	Pleasant	3.59	Very pleasant
Absorption of lecture material	3.26	Many	3.82	A huge amount

These learning aspects affect the absorption of learning materials (Rahmati et al., 2018; Serevina & Muliyati, 2015). The modification of the discussion method carried out, creates a positive perception of students toward the ability of lecturers, increases learning activity, presents a pleasant atmosphere, and ultimately increases the ability to absorb lecture material students (Ermi, 2015; Nulhakim et al., 2020). A summary of the four aspects of the study is listed in Table 6.

Conclusion

Based on the data and analysis obtained an increase in the quality of the four aspects of this research study. The quality of the lecturer's ability to manage lectures increased from good criteria (control) to very good (experimental). Student activity in lectures increased from active criteria (control) to very active (experimental). The atmosphere of the lecture increased from fun (control) to very pleasant (experimental). The ability to absorb lecture material students increased from a lot category (control) to a lot (experimental). So, the innovation of the discussion method in ESS lectures in the fall semester of the 2019/2020 academic year for students of the Department of Physics Education FKIP USK, improved the ability of lecturers, increase student activity, provide a fun learning atmosphere, and increase students' ability to absorb material in the lecture process.

Acknowledgments

Thanks are conveyed to the leadership and staff from the Faculty of Teacher Training and Education, Department of Physics Education, Research Institute and Service to

community Syiah Kuala University, and the research team and parties who have assisted in the implementation of this research.

Author Contributions

The authors in the study have their respective roles and contributions in completing this research. Ahmad Farhan as the first author contributed to planning research activities and organizing all research activities. Elisa as the second author, contributed to compiling the research instruments. Fitria Herliana as the third author contributed to writing the article manuscript. Sri Wahyuni as the fourth author contributed to editing and layout of the manuscript according to the template. Evita Kharisma as the fifth author contributed to collecting research data in the field.

Funding

No funding.

Conflicts of Interest

No conflict interest.

References

Akbar, R. (2017). *Aktivitas Fiding Dory: Uji Daya Ingat*. Aneka Ilmu.

Alawi, D., Sumpena, A., Supiana, S., & Zaqiah, Q. Y. (2022). Implementasi Kurikulum Merdeka Belajar Kampus Merdeka Pasca Pandemi Covid-19. *Edukatif: Jurnal Ilmu Pendidikan*, *4*(4), 5863–5873. https://doi.org/10.31004/edukatif.v4i4.3531

Apriliyani, N. V., Hernawan, D., Purnamasari, I., Goris Seran, G., & Sastrawan, B. (2022). Implementasi Program Merdeka Belajar Kampus Merdeka. *Jurnal Governansi*, *8*(1), 11–18. https://doi.org/10.30997/jgs.v8i1.5045

Baharuddin, M. R. (2021). Adaptasi Kurikulum Merdeka Belajar Kampus Merdeka (Fokus: Model MBKM Program Studi). *Jurnal Studi Guru Dan Pembelajaran*, *4*(1), 195–205. https://doi.org/10.30605/jsgp.4.1.2021.591

Doyan, A., Gunada, W., -, S., & Adriani, I. Ay. D. (2017). Perbedaan Pengaruh Model Pembelajaran Kooperatif Tipe Stad Dan Tipe Jigsaw Terhadap Hasil Belajar Fisika Ditinjau Dari Motivasi Belajar Siswa. *Jurnal Penelitian Pendidikan IPA*, *1*(1), 1–13. https://doi.org/10.29303/jppipa.v1i1.1

Ermi, N. (2015). Penggunaan metode diskusi untuk meningkatkan hasil belajar materi perubahan sosial pada siswa kelas XII SMA Negeri 4 Pekanbaru. *SOROT*, *10*(2), 155. https://doi.org/10.31258/sorot.10.2.3212

Farhan, A. (2019). *Rencana pembelajaran semester kuliah IPBA jurusan pendidikan fisika FKIP unsyiah semester ganjil tahun ajaran 2019/2020*. Pendidkan Fisika FKIP Unsyiah.

Farhan, A., Herliana, F., Evendi, E., Devy, N. K., & Mauliza, F. (2021). The implementation of "Guru Penggerak" (Organizer Teachers) concept to innovation of the discussion methods in thermodynamics course. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *7*(1), 1–12. https://doi.org/10.21009/1.07101

Fauziah, A. N. M., Nurita, T., Mahdiannur, M. A., & Ramadhani, P. W. (2021). Development of Earth and Space Knowledge Competencies for Science Teacher Candidates: Field-Project Based Learning Perspectives. *Jurnal Penelitian Pendidikan IPA*, *7*(3), 474–480. https://doi.org/10.29303/jppipa.v7i3.731

Hardini, I., & Puspitasari, D. (2012). *Strategi Pembelajaran Terpadu*. Familia.

Hilmi, N., Harjono, A., & Soeprianto, H. (2017). Pengaruh Model Pembelajaran Discovery dengan Pendekatan Saintifik dan Keterampilan Proses terhadap Hasil Belajar Fisika Peserta Didik. *Jurnal Penelitian Pendidikan IPA*, *3*(2). https://doi.org/10.29303/jppipa.v3i2.95

Jufri, A. W., Ramdani, A., Jamaluddin, J., & Azizah, A. (2019). Development of Scientific Literacy and Pedagogical Content Knowledge (PCK) of Prospective Science Teachers through Lesson Study-Based Courses. *Jurnal Penelitian Pendidikan IPA*, *5*(2), 179. https://doi.org/10.29303/jppipa.v5i2.235

Kompasnia. (2019). *Memaknai Kemerdekaan Belajar Mas Mendikbud Nadiem Makarim*. Retrieved from https://Www.Kompasiana.Com/, 1–4. https://www.kompasiana.com/uweschaeruman7904/5dfe2221097f3645ad15f433/memaknai-kemerdekaan-belajar-mas-mendikbud-nadiem-makarim

Mariati, M. (2021). Tantangan Pengembangan Kurikulum Merdeka Belajar Kampus Merdeka di Perguruan Tinggi. In *Seminar Nasional Teknologi Edukasi Sosial Dan Humaniora* (Vol. 1, No. 1, pp. 749-761). https://doi.org/10.53695/SINTESA.V1I1.405

Marjan Fuadi, T. (2022). Konsep Merdeka Belajar-Kampus Merdeka (Mbkm) : Aplikasinya Dalam Pendidikan Biologi. *Prosiding Seminar Nasional Biotik*, *9*(2), 38. https://doi.org/10.22373/pbio.v9i2.11594

Mauizdati, N. (2020). Kebijakan Merdeka Belajar dalam Perspektif Sekolahnya Manusia dari Munif Chatib. *Jurnal Review Pendidikan Dan Pengajaran*, *3*, 315–321. https://doi.org/10.31004/jrpp.v3i2.1324

Nulhakim, L., Setiawan, F. R., & Saefullah, A. (2020). Improving students' creative thinking skills using Problem-Based Learning (PBL) models assisted by interactive multimedia. *Jurnal Penelitian &*

Pengembangan Pendidikan Fisika, *6*(1), 9–16. https://doi.org/10.21009/1.06102

Pakpahan, H. M., Suherni, S., Pujiati, L., & Girsang, R. (2023). Effectiveness of Indonesian Education Curriculum Reform on the Quality of Processes in Learning. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 564–569. https://doi.org/10.29303/jppipa.v9i1.3930

Prawitasari, B., & Suharto, N. (2020). The role of guru penggerak (organizer teacher) in komunitas guru belajar (teacher learning community). *Proceedings of the 3rd International Conference on Research of Educational Administration and Management (ICREAM 2019)*, 86–9,. https://doi.org/10.2991/assehr.k.200130.145

Prodjo, W. A. (2019). Upacara hari guru nasional, Nadiem bicara soal merdeka belajar dan guru penggerak'. Retrieved from https://edukasi.kompas.com/read/2019/11/25/13013201/upacara-hari-guru-nasional-nadiem-bicara-soal-merdeka-belajar-dan-guru?page=all

Putri, M. D., Lubis, N. A., & Fairuz, T. (2023). Quality of Student Scientific Argumentation Through the Application of Problem-Based Learning With Flipped Classroom Approach. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 369–377. https://doi.org/10.29303/jppipa.v9i1.2504

Rahmati, R., Yusrizal, Y., & Hasan, M. (2018). Critical thinking skills enhancement of students through inquiry learning model laboratory based on reflection of the light. *Jurnal IPA & Pembelajaran IPA*, *1*(1), 34–41. https://doi.org/10.24815/jipi.v1i1.9564

Rajagukguk, S., Sinaga, A. H., Piliang, F. M., Tanjung, A., & Asmayani. (2023). Effect of Multimedia Utilization on Increasing Students Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 5845–5851. https://doi.org/10.29303/jppipa.v9i8.4181

Serevina, V., & Muliyati, D. (2015). Peningkatan hasil belajar siswa pada materi dinamika gerak partikel dengan menerapkan model pembelajaran project based learning. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *01*(1), 61–68. https://doi.org/10.21009/1.01109

Setiawan, D., Ashari, R. B., Ansori, I., Fathurrahman, M., Kiptiyah, S. M., & Tyas, N. (2023). *Actualization of Science Literacy in the Freedom Era of Studying in the City of Semarang*. *9*(9), 7238–7248. https://doi.org/10.29303/jppipa.v9i9.4219

Sumiati. (2009). *Metode Pembelajaran*. Wacana Prima.

Wahyuddin, W., & Nurcahaya, N. (2019). Efektivitas pembelajaran matematika melalui pembelajaran aktif tipe Everyone is a Teacher Here (ETH) pada siswa kelas X SMA Negeri 8 Takalar. *Al Khawarizmi: Jurnal Pendidikan Dan Pembelajaran Matematika*, *2*(1), 72. https://doi.org/10.22373/jppm.v2i1.4500

Widianingtiyas, L., Siswoyo, S., & Bakri, F. (2015). Pengaruh pendekatan multi representasi dalam pembelajaran fisika terhadap kemampuan kognitif siswa SMA. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *01*(1), 31–38. https://doi.org/10.21009/1.01105

Yamin, M., & Syahrir, S. (2020). Pembangunan Pendidikan Merdeka Belajar (Telaah Metode Pembelajaran). *Jurnal Ilmiah Mandala Education*, *6*. https://doi.org/10.36312/jime.v6i1.1121

Yuliana, Y., Wahyudi, W., Doyan, A., & Pineda, C. I. S. (2021). Development of Phet Simulation-Assisted Inquiry Model Learning in Elasticity Materials. *Jurnal Penelitian Pendidikan IPA*, *7*(2), 178. https://doi.org/10.29303/jppipa.v7i2.505

Yuliati, Y., Doyan, A., & Sahidu, H. (2021). Development of Inkuiri Model Learning Tools Guided to Improve Concept Mastery Learner Physics. *Jurnal Penelitian Pendidikan IPA*, *7*(3), 422. https://doi.org/10.29303/jppipa.v7i3.564

Zulfiani, Feronika, T., & Suartini, K. (2009). *Strategi Pembelajaran Sains*. Lembaga Penelitian UIN Syarif Hidayatullah. Retrieved from https://repository.uinjkt.ac.id/dspace/bitstream/123456789/46671/1/SPB.pdf