

Instructional Creativity, Innovation Practices, and Digital Literacy for an Improved Classroom Ecosystem

Maila L. Cortez^a & Elisa N. Chua^b

^a*maila.cortez@deped.gov.ph*, ^b*elisa.chua@lspu.edu.ph*

¹ *Elementary Grade Teacher I, School, San Pablo City, 4000, Philippines*

² *Associate Professor V, Laguna State Polytechnic University, San Pablo City, 4000, Philippines*

Abstract

This study aimed to determine the instructional creativity, innovation practices, and digital literacy for an improved classroom ecosystem. This specifically aimed to answer the instructional creativity of teachers manifested in a class as to designed based learning, problem solving, creativity thinking, and research-based learning. Also, the innovation practices of teachers as to brainstorming, discussion, collaboration, and team-based/group work. Then, the level of teacher's digital literacy as to utilization of ICT Tools, operation of software office, and selection of digital learning resource media and how is the classroom ecosystem described as to its effectiveness in terms of engaging content, classroom layout and design, instructional routines and procedures, pupil's interest, administration and leadership, and classroom observation. The study utilized the descriptive correlational design with which includes 172 out of 239 teachers in San Francisco District, Division of San Pablo City during the School Year 2022-2023. The four-part survey questionnaire was utilized to determine and interpret the instructional creativity, innovation practices, digital literacy, and classroom ecosystem. The results revealed that there is a significant relationship between the instructional creativity, innovation practices, digital literacy, and classroom ecosystem thus, the null hypothesis was not supported by the findings of the study when the test of correlation was made and therefore not sustained.

Keywords: *instructional creativity; innovation practices; digital literacy; classroom ecosystem*

I. Introduction

The United Nations Educational Scientific and Cultural Organization (UNESCO) stated that educational technology (EdTech) refers to the utilization of digital tools to help educational tasks such as teaching and learning. Teachers' utilization of digital technology provides a more well-known learning experience for pupils in the present day. Information and communication technology (ICT) is applied in the field of education using digital technologies. Information and Communication Technology encompasses various technologies used for transmitting, processing, storing, creating, displaying, sharing, or exchanging information electronically. As a result, teachers employ instructional creativity, innovative practices, and digital literacy to enhance learning. They achieve this by developing classes utilizing software office tools and setting up email and social media channels for both parents and children to communicate. According to research, a teacher's capacity to use technology in the planning and execution of student centered learning activities is essential for enhancing the learning environment in the classroom. (Selwyn, N. 2021).

Education innovation techniques must adapt to a changing environment and effectively address academic issues. Good quality innovation practices in education can accelerate learning and enhance learning competence, enabling learners to absorb more information in a shorter timeframe. It was stated that implementing innovative teaching methods is essential for learning because it aids students in fully understanding the lesson's material. Learning processes are developed by learners, and these processes influence their desired features. As a result, each sort of

activity needs to have produced innovation practices researched (Seechaliao, T. 2017).

The Office of the Undersecretary for Administration (OUA), through the Information and Communication Technology Service (ICTS), shall continue the services provided by the Educational Technology (EdTech) Unit regarding the mandate of the Department of Education (DepEd) to formulate, implement, and coordinate policies, plans, programs, and projects in the areas of formal and non-formal basic education. According to OUA Memorandum 14-0120-0588, dated January 15, 2020, this is the case. The EdTech Unit will continue to fulfill its mandate to support and empower learners and instructors in public schools in accordance with the global demand for the rapid advancement of education. It is important to support and institutionalize the innovation techniques and digitization that will enable learning and provide everyone with access to high-quality, relevant, and liberating education. This is supplemented with empowerment training programs in emerging technologies for public school teachers (DepEd, 2020).

The health crisis experienced worldwide, which led to the conditions involving schools constantly changing, made it particularly significant for the utilization of digital technology to help teachers improve their classroom ecosystem. In connection, the DepEd Division of San Pablo City conducts training workshop, programs and activities that are devoted to enhancing educational quality through integration of instructional creativity, innovation practices, and digital literacy as to improved classroom ecosystem. They apply the EdTech Unit's program which focuses on the strategic goals, objectives, and functions. Like the use of digital literacy which includes the utilization of ICT tools, operation of software office and selection of digital learning resource media. These are some of the EdTech Unit's projects and activities that are assisting teachers in continuing to educate pupils.

By incorporating instructional creativity, innovation practices, and digital literacy into the classroom, educators can create an environment that encourages exploration, fosters critical thinking, and prepares students for the challenges and opportunities of the 24th century. This holistic approach not only enhances students' academic growth but also nurtures their creativity, adaptability, and digital fluency, ultimately creating an improved classroom ecosystem that supports lifelong learning. Regarding the above explanation, the aim of the paper was to benefit instructional creativity, innovation practices, and digital literacy to support and provide an improved classroom ecosystem. Researchers needed to study and convey the outcome of this paper so that there was an effectiveness about what teachers did in helping students after educational emergencies due to the health crisis. With this, there would be input to evaluate teachers' improved classroom ecosystem.

II. Methodology

The study used a descriptive and correlational method of research to gather the relationship between instructional creativity, innovation, digital literacy for an improved classroom ecosystem. It was a quantitative correlational research design that measured a relationship between two variables without the researcher controlling either of them. Besides, the correlation method helped to determine if two or more variables were associated with each other. The use of a descriptive and correlational design focused on the current situation in which occurrences were collected, reported, evaluated, analyzed, and interpreted the obtained data.

This study was conducted in the public elementary schools of San Francisco District in the Division of San Pablo City, province of Laguna. The respondents involved were one hundred seventy-two (172) teachers from eleven (11) schools. Most of the respondents are in age of 26-30 years old with 40 responses or 23.3 %, in terms of sex most of them are female with 156 responses or 90.7 %, their civil status is all married with 112 responses or 65.1 %. In terms of designation, most of the teachers are in teacher III with 72 responses or 41.9 %, in terms of educational attainment most of them are with MA Units with 69 responses or 40.1 %, and their length of service are in 0-5 years with 55 responses or 32 %.

The researcher made use of an adapted survey questionnaire in gathering the data. The survey questionnaire was composed of four parts: instructional creativity questionnaire, innovation practices questionnaire, digital literacy questionnaire, and classroom ecosystem questionnaire. This method was used to simplify the data gathering.

The study used statistical measures. Mean and standard deviation were used to determine the extent of instructional creativity, innovation practices, level of digital literacy and an improved classroom ecosystem. Furthermore, to test the hypothesis, Pearson Product-Moment Correlation Coefficient was used to estimate a significance level of 0.05 for correlation.

III. Result and Discussion

This chapter includes tables that present the results of the study with corresponding analyses and interpretations.

Table 1. Instructional Creativity of Teachers as to Designed Based Learning

	Indicators Mean SD VI
1. use social media to make, present, and share various pieces of information.	3.80 0.42 HM
2. extend the use of ICT in this kind of instruction directed learning.	3.74 0.44 HM
3. play the consultant, challenging the student with questions and techniques that provide scaffolding.	3.74 0.45 HM
4. create contextualized and modern learning in design tasks that can make pupils resort to real-life situations.	3.71 0.45 HM
5. incorporate components of design-based learning environments that promote digital literacy and design thinking in the classroom.	3.71 0.46 HM
6. consider design-based learning in the classroom, particularly when using technology tools.	3.71 0.47 HM

Overall 3.73 0.36 HM

Legend: 3.50-4.00- Highly Manifested 1.50-2.49- Slightly Manifested 2.50-3.49- Moderately Manifested 1.00-1.49- Not Manifested

The table shows the data with mean perception of the teachers related to instructional creativity as to designed based learning. This reveals that designed based learning of the teachers was highly manifested in a class.

One indicator shows that the teacher respondents use social media to make, present, and share various pieces of information was highly manifested. Thus, the result implies that the use of ICT is viewed positively. This is supported of using DepEd Order No. 42, Section, the Department of Education has created tools for classroom observation. Using suitable teaching and learning resources, including ICT, to address learning goals was mentioned in 2017 as number 8 of the COT Tools. The teachers of San Francisco District have been significantly exposed to technology

during health crises. With the shift to remote learning, teachers have had to rapidly adapt their teaching methods and embrace various technological tools. Virtual classrooms, learning management systems, and educational apps have become essential in creating contextualized and modern learning in design tasks that can make pupils resort to real life situations. Teachers have had to master these technology tools to deliver lessons, communicate with students, provide assignments, and feedback, and monitor progress. They have also explored innovative approaches such as recorded video lessons, interactive presentations, and online assessments to maintain student engagement and ensure effective learning.

Furthermore, technology has enabled teachers to access a wide range of digital resources, educational websites, and online communities for professional development and sharing best practices. Although the transition has presented challenges, teachers' exposure to technology during health crises has paved the way for the integration of digital tools and pedagogies in the future of education. Also, schools head in San Francisco District provide professional development opportunities for teachers to enhance their skills in using social media as a tool for making, presenting, and sharing information. This included workshops or training sessions on effective use of social media platforms for educational purposes.

Table 2. Innovation Practices of Teachers as to Brainstorming

	Indicators Mean SD VI
1. stimulate active participation and create the possibility of contagion of ideas with the help of digital literacy.	2. am useful if there is strong conflict within the group, or if the topic is highly 3.72 0.49 PGE
controversial.	3.65 0.52 PGE
3. foster more benefits from brainstorming activities to generate improvements that affect group idea performance during class.	3.69 0.48 PGE
4. explicit instruction of brainstorming strategy has a positive effect on the better learning of pupils.	3.69 0.48 PGE
5. assess and foster the creativity of pupils using brainstorming which integrate a system that consists of multimedia.	3.68 0.48 PGE
	Overall 3.67 0.44 PGE

Legend: 3.50-4.00- Practiced to a Great Extent 1.50-2.49- Practiced to a Less Extent 2.50-3.49- Practiced to a Moderate Extent 1.00-1.49- Not Practiced at All

The table presents data on the innovation practices of teachers regarding brainstorming. It can be shown in the table that teachers' practiced innovation to a great extent at school as to brainstorming, collaboration, discussion, and team-based/group work.

In general, the data reveal that teachers in San Francisco District are opened to used digital tools and multimedia to stimulate active participation and foster creativity in brainstorming activities. Many teachers recognized the benefits of incorporating technology in their instruction, such as increased student engagement, personalized learning, and the ability to create more dynamic and interactive lessons. The district has implemented various initiatives to support teachers in integrating technology into their teaching practices. For instance, the district provides professional development opportunities like training and seminars. They are given access to digital resources and tools to help teachers enhance their innovation practices and effectively use technology in the classroom.

Additionally, the district has also encouraged teachers to collaborate and share best practices for integrating technology in the classroom through professional learning communities and online forums. Through these efforts, teachers in the San Francisco District have become more comfortable in using digital tools and multimedia in their instruction, allowing for more dynamic and engaging learning experiences for students.

Table 3. Level of Teachers’ Digital Literacy as to Utilization of ICT Tools

	Indicators Mean SD VI
1. use ICT tools to access the learning materials. It improves the presentation of materials in my lessons.	3.72 0.47 HL
2. use ICT tools in instructing the lesson to my pupils. It makes my lessons more diverse and interesting.	3.71 0.47 HL
3.am focus on teaching the pupils to participate in an E-learning System to encourage formal learning activities using	3.59 0.54 HL
4. emphasize the importance of continuing the learning digital tool such as laptop, and smart phone. equipping classrooms with computers and an Internet connection.	3.63 0.52 HL
5. implement the use of ICT to extend beyond	3.62 0.51 HL

Overall 3.65 0.43 HL

**Legend: 3.50-4.00- Highly Literate 1.50-2.49- Slightly Literate
2.50-3.49- Moderately Literate 1.00-1.49- Poorly Literate**

The table shows appears that teachers are highly literate as to utilizing ICT tools in their teaching practices. Teachers reported that they use ICT tools to access and present learning materials, as well as to instruct lessons to their pupils. They also prioritize teaching pupils how to participate in e-learning systems to encourage formal learning and emphasize the importance of continuing learning activities using digital tools such as laptops and smartphones. Additionally, teachers implement the use of ICT beyond simply equipping classrooms with computers and an internet connection to extend the scope of learning.

In conclusion, the data indicates that teachers are highly literate because during the health crisis the Deped avenue training/seminar, School Learning Action Cell or SLAC which focuses on integrating ICT or technology into

their teaching methods. These results also highlight the importance of technology as the work of teacher are made easier and it simplifies the skill for teachers to possess in today's technology-driven world.

Table 4. Effectiveness of Classroom Ecosystem as to Engaging Content

	Indicators	Mean	SD	VI
1. have mastery of the content which helps me impart the knowledge effectively and confidently.	strategies that can help my	3.81	0.40	HE
2. use my level of digital skills and different				
pupils master the content.	HE 3. am “enabler”, whereby ICT can access by pupils to learning which	3.71	0.45	
increases motivation and improves self-esteem.	HE 4. improve the learning experience by using ICT to make the classroom	3.65	0.50	
material more interesting and accessible.	HE 5. develop learning technology systems that will be enriched with	3.71	0.46	
<u>intelligent techniques to pupil traits.</u>		3.59	0.52	HE
Overall 3.69 0.39 HE				

Legend: 3.50-4.00- Highly Effective 1.50-2.49- Slightly Effective 2.50-3.49- Moderately Effective 1.00-1.49- Poorly Effective

Table 4 shows the classroom ecosystem as to engaging content is highly effective. Teachers are highly effective in having mastery of the content, which helps them impart knowledge effectively and confidently, using their level of digital skills and different strategies that can help pupils master the content and improve the learning experience by using ICT to make the classroom material more interesting and accessible.

Overall, the data impart that many of the teachers incorporate the depth ICT by integrating simple technologies power point, games, internet, homework, or grading can be difference makers in pupils’ growth in the classroom. Also using ICT Tools like computers, projectors, and printers can possess a high level of effectiveness in utilizing digital skills and strategies to help their pupils master the content.

Table 5. Correlation Between Instructional Creativity and Classroom Ecosystem

Instructional Creativity	Engaging Content Classroom	Layout and Design Instructional Routines and	Classroom Ecosystem			Observation
			Procedures	Pupils Interest Administration	and Leadership Classroom	
Designed			learning Problem			
based			.715**	.704**	.695**	.696** .676** .681**

solving .724** .743** .718** .720** .715** .695** Creative
 thinking .678** .708** .683** .699** .658** .675** Research
 based learning
 .744** .756** .726** .753** .706** .718**

** . Correlation is significant at the 0.01 level (2-tailed).

Table 5 shows the correlations between Instructional Creativity and Classroom Ecosystem. All the correlations between Instructional Creativity and the Classroom Ecosystem factors are significant at the 0.01 level (2-tailed), which means that there is a significant relationship between Instructional Creativity and the Classroom Ecosystem. Highly correlated are found between Instructional Creativity and Classroom Layout and Design, Instructional Routines and Procedures, Pupils' Interest, and Administration and Leadership. This suggests that these factors are particularly important in fostering instructional creativity in the classroom.

Another factor used of teacher respondents that show the significant relationship between instructional creativity and classroom ecosystem is like the use of differentiated learning which an approach to teaching and learning that recognizes and accommodates the diverse needs, abilities, interests, and learning styles of students within a classroom. By implementing differentiated learning strategies, teachers aim to create a student-centered learning environment that fosters engagement, motivation, and academic growth. The approach recognizes and values the unique qualities and potential of each learner while promoting inclusivity and equity in education.

Thus, the implications of the correlations are that teacher respondents take steps to enhance instructional creativity in their classrooms by focusing on using technology. For example, by paying attention to classroom layout and design, teachers respondents creating a modern environment that is conducive to creativity and exploration by the help of technology. By establishing clear instructional routines and procedures, teachers provide multimedia structure which support pupils while also encouraging them to think creatively and outside the box. Similarly, by taking steps to understand and foster pupils' interests and by providing effective leadership and administration, teachers create a modern classroom environment that supports and nurtures instructional creativity.

In summary, the table suggests that teachers strategic in incorporating instructional creativity with support and foster of technology is resulted in a highly effective classroom ecosystem because the teacher respondents in San Francisco District are utilized the instructional creativity as concept, method, or approach which manifested in a class who possess a strong knowledge base in their subject area and pedagogical skills are more likely to effectively engage students and foster problem-solving abilities.

Their expertise enables them to design engaging lessons, differentiate instruction to meet individual needs, and facilitate innovative and adaptable learning experiences. Teachers who differentiate instruction to accommodate students' diverse learning needs and abilities can better engage them in the learning process. By tailoring content, activities, and assessments, teachers can address individual strengths, interests, and challenges, which helps promote personalized learning and problem-solving skills.

Marc Prensky (2014) stated that integrating technology tools and resources can enhance engagement, personalized learning, and problem-solving abilities. Educational technology can provide interactive and immersive experiences, facilitate access to diverse learning materials, and offer adaptive learning platforms that cater to individual needs. Additionally, technology allows or innovative teaching strategies and enables teachers to adapt their instruction to changing circumstances.

Table 6. Correlation Between Innovation Practices and Classroom Ecosystem

Innovation Practices	Classroom Ecosystem					
	Content Classroom Layout and Design	Instructional Routines	and Pupils' <u>Procedures</u>	Interest Administration and	Leadership Classroom	Observation
Engaging						
Brainstorming	.754**	.783**	.773**	.781**	.727**	.712**
Collaboration	.721**	.795**	.756**	.763**	.738**	
Discussion	.672**	.718**	.715**	.718**	.700**	.715**
Team based/group work	.691**	.736**	.701**	.693**	.676**	.713**

** . Correlation is significant at the 0.01 level (2-tailed).

The data presented in the table shows the correlation between innovation practices and classroom ecosystem. All innovation practices show a significant relationship to each variable of the classroom ecosystem.

The implication of the correlation between innovation practices and the classroom ecosystem based on the table above is that innovation practices can be an effective way to improve the classroom environment. This means that teacher of San Francisco District used innovation practices such as brainstorming, collaboration, discussion, and team based/group work that utilizing technology are see positive results in terms of pupil’s engagement and learning outcomes. Teachers can use practices of integrating technology to create a more effective and engaging learning environment for their pupils.

There is a strong correlation between innovation practices and the classroom ecosystem, as both contribute to creating an environment that fosters creativity thinking, problem solving and overall students’ engagement. When innovation practices are integrated into the classroom ecosystem, students are more likely to develop skills and competencies needed for the 24th century workforce.

Innovation practices encourage creative thinking by promoting divergent and conventional approaches to problem solving. According to Cropley et al (2017), integrating creativity enhancing technologies in the classroom ecosystem can stimulate students’ creativity and support innovative thinking.

Table 7. Correlation Between Digital Literacy and Classroom Ecosystem

Digital Literacy	Utilization of Engaging	Classroom Ecosystem			
		Content Classroom Layout and Design	Instructional Routines and <u>Procedures</u>	Pupils' Interest Administration and	Leadership Classroom
					Observation

ICT Tools .721** .806** .812** .819** .782** .780** Operation of
Software Office .841** .801** .816** .799** .810**
Selection of Digital
Learning Resource Media
.792** .828** .820** .865** .830** .848** .774**

** Correlation is significant at the 0.01 level (2-tailed).

Table 7 presents the correlations between digital literacy and classroom ecosystem. The table indicates that there is significant relationship between digital literacy and classroom ecosystem. This suggests that proficiency in software tools is highly important for effectively utilizing digital resources in the classroom.

The table suggests that a positive and supportive classroom ecosystem can enhance digital literacy skills among pupils. The teacher respondents' results said that teacher's work can easier today's education because technology offers a wide range of digital tools and platforms that simplify lesson planning and resource management. Teachers can access online libraries, educational websites, and databases to find relevant teaching materials, lesson plans, and multimedia resources. The successful integration of technology in teaching is a significant support and assistance of teachers in their various aspects of the work.

There is a strong correlation between digital literacy and the classroom ecosystem because digital literacy skills are essential for students to thrive in today's technology-driven world. Integrating digital literacy into the classroom ecosystem help students develop the necessary competencies to navigate, critically evaluate, and create digital content. It also enhances their overall learning experiences and prepare them for future academic and professional success.

As prove of Hargittai E.(2008) digital literacy enables students to access a vast amount of information and educational resources available online. It allows them to effective by search for, evaluate, and utilize digital content to support their learning. Study by Hargittai and Walejko (2008) highlights the importance of digital literacy in facilitating access to information and resources for educational purposes.

Acknowledgements

The researcher would like to express her deep appreciation to everyone involved in the successful completion of this study.

Dr. Mario R. Briones, the President of Laguna State Polytechnic University, is recognized for enhancing the institution and serving as a source of motivation for all the students.

Dr. Eden C. Callo, the Vice President of Laguna State Polytechnic University, San Pablo Campus, and my statistician, for her expertise in statistics has been instrumental in the success of this research, and her guidance and support have been invaluable in shaping my research methodology and data analysis.

Dr. Edilberto Z. Andal, the Dean of College of Teacher Education and my subject specialist, for his

grateful leadership and guidance, which have created an environment conducive to academic excellence, for serving as a positive example for other educators and students and for his unwavering support and encouragement throughout my academic journey.

Dr. Elisa N. Chua, my research adviser, for her invaluable guidance and support throughout this research study, for providing her with this wonderful opportunity to work with such a knowledgeable and supportive adviser. Her expertise and feedback were instrumental in shaping this thesis and enhancing its quality.

Dr. Teresa M. Yambao, my technical editor, for her meticulousness, attention to detail, and expertise in technical writing which have significantly improved the clarity and readability of my work. Her guidance and support have been invaluable in shaping my technical writing skills.

Schools Division Superintendent, Public School District Supervisor, and School Head, for granting me the opportunity to conduct my research study within the school premises and for their understanding, support, and invaluable contribution to my academic success.

Teacher Respondents, for their patience and dedication in responding to my survey questions. Their contributions have been instrumental in shaping the direction of my study and providing a comprehensive understanding of the research problem.

Family, Friends, Colleagues, and Loved Ones, for their support has been an essential source of strength and inspiration, especially during the challenging and demanding phases of my research study. Their unwavering belief in my abilities, unconditional love and their constant encouragement have been the driving force behind my academic success.

And above all, to **God Almighty**, for the divine wisdom, perseverance, and grace have helped me navigate through the challenges and uncertainties of my research study. These were bestowed upon the researcher.

References

- Abrar, M., & Mukminin, A. (2016). International graduate classroom discussion engagement, challenges, and solving-strategies. *Asia-Pacific Collaborative education Journal*, 12(1), 5-19.
- Arceo, J.M. & Chua, E.N. (2022). Organizational Dynamics and Stewardship in Promoting Innovative Work Behavior and Commitment at Work. *International Journal of Academe and Industry Research*, Volume 3 Issue 3, pp. 65 - 86.
- Avalos-Bravo, V., Arellano, C. C., & González, J. T. (2022). Modular Educational Ecosystem as Academic Support During COVID-19 Emergency at Mexico City-IPN in 2020. In *Perspectives and Trends in Education and Technology* (pp. 47-58). Springer, Singapore.
- Beg, S., Halim, W., Lucas, A. M., & Saif, U. (2022). Engaging teachers with technology increased achievement, bypassing teachers did not. *American Economic Journal: Economic Policy*, 14(2), 61-90.
- Berry III, R. Q. (2018). Thinking about instructional routines in mathematics teaching and learning. *National Council of Teachers of Mathematics*.
- Bicer, A. (2021). A Systematic Literature Review: Discipline-Specific and General Instructional Practices Fostering the Mathematical Creativity of Students. *International Journal of Education in Mathematics, Science and Technology*, 9(2), 252-281.
- Boylan, M. (2016). Deepening system leadership: Teachers leading from below. *Educational management administration & leadership*, 44(1), 57-72.
- Chiappe, A., Samper, A. M. T. D., Wills, A. E., & Restrepo, I. (2019). Rethinking

- 21st century schools: the quest for lifelong learning ecosystems. *Ensaio: Avaliação e Políticas Públicas em Educação*, 28, 521-544.
- Dolmans, D., Michaelsen, L., Van Merriënboer, J., & van der Vleuten, C. (2015). Should we choose between problem-based learning and team-based learning? No, combine the best of both worlds!. *Medical teacher*, 37(4), 354-359.
- Ersoy, E. (2014). The effects of problem-based learning method in higher education on creative thinking. *Procedia-Social and Behavioral Sciences*, 116, 3494-3498.
- Ford, A. (2016). Planning Classroom Design and Layout to Increase Pedagogical Options for Secondary Teachers. *Educational Planning*, 23(1), 25-33.
- Hargittai E. & Walejko G. (2008) The participation divide: Content creation and sharing in digital age. *Information and Communication & Society*, u(2). 239-256.
- Huang, Z., Peng, A., Yang, T., Deng, S., & He, Y. (2020). A design-based learning approach for fostering sustainability competency in engineering education. *Sustainability*, 12(7), 2958.
- Ince, E. (2018). An Overview of Problem Solving Studies in Physics Education. *Journal of Education and Learning*, 7(4), 191-200.
- Larasati, A., Hajji, A. M., & Handayani, A. N. (2019, January). Preferences analysis of engineering students on choosing learning media using support vector machine (SVM) model. In *2nd International Conference on Vocational Education and Training (ICOVET 2018)* (pp. 57-59). Atlantis Press.
- Lortie, K. (2020). Impact of Modern Technology on Education. *IDOSR JOURNAL OF CURRENT ISSUES IN SOCIAL SCIENCES*, 6(1), 40-44.
- Morgan, B., & Martin, I. (2014). Toward a research agenda for classroom-as ecosystem. *The Modern Language Journal*, 98(2), 667-670.
- Öqvist, A., & Malmström, M. (2016). Teachers' leadership: A maker or a breaker Of students' educational motivation. *School Leadership & Management*, 36(4), 365-380.
- Serdyukov, P. (2017). Innovation in education: what works, what doesn't, and what to do about it?. *Journal of Research in Innovative Teaching & Learning*.
- Selwyn, N. (2021). Digital technology and the futures of education: Towards 'Non Stupid' optimism.
- Unin, N. (2016). Brainstorming as a Way to Approach Student-centered Learning in the ESL Classroom. *Procedia-Social and Behavioral Sciences*, 224, 605-612.
- Usmeldi, U., Amini, R., & Trisna, S. (2017). The development of research-based learning model with science, environment, technology, and society approaches to improve critical thinking of students. *Jurnal Pendidikan IPA Indonesia*, 6(2), 318-325.
- Widana, I. W. (2020, July). The effect of digital literacy on the ability of teachers to develop HOTS-based assessment. In *Journal of Physics: Conference Series* (Vol. 1503, No. 1, p. 012045). IOP Publishing.
- Zinkovskaya, A. V., Katermina, V. V., & Plaxin, V. A. (2020, May). Remote Technologies in the Field of Foreign Language Teaching as a Part of the Digital Education Ecosystem. In *International Scientific Conference "Digitalization of Education: History, Trends and Prospects" (DETP 2020)* (pp. 681-684). Atlantis Press.