



## Strategies To Improve Teachers' Pedagogical Skills in Science Learning

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### ABSTRACT

This research aims to develop effective strategies to enhance teachers' pedagogical skills in science learning. Employing a mixed methods approach, combining qualitative and quantitative methodologies, the study investigates current challenges and gaps in pedagogical practices within science education. Data collection methods include literature review, observation, and questionnaire, followed by qualitative data analysis involving data reduction, presentation, and conclusion, as well as descriptive analysis of quantitative data. The research findings indicate that effective strategies for improving teachers' pedagogical skills in science learning encompass the development of teacher competencies in content delivery, technology utilization, interpersonal interaction management, and resource utilization. The implementation of these strategies has been shown to significantly enhance teachers' pedagogical skills in science learning, as evidenced by a significance value of  $0.000 < 0.05$ . Thus, this research provides a significant contribution to enhancing science learning practices through the improvement of teachers' pedagogical skills.

**Keywords:** Strategy, Skills, Pedagogy, Teachers, Science Learning.

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### INTRODUCTION

Education serves as a tool for molding the moral fiber of a country's populace. It encompasses the transformation of individuals or collectives, guiding them towards maturity through instruction and practice. In Indonesia, education is categorized into three forms: formal education within schools, non-formal education typically within religious institutions, and informal education conducted within familial or private settings (Magfiroh, Irfan, Rahmat, & Ruhaya, 2023). The educational process is implemented with teaching provided by teachers, teaching is a process that involves complexity. This not only includes sending information from

teachers to students, but also includes various activities and actions that must be carried out (Bangun, Purnama, & Panjaitan, 2022).

Every teacher when teaching has a variety of unique skills and approaches. Teachers use different teaching strategies, emphasize different aspects of the subject matter, and have diverse communication styles. This shows that each teacher is unique in the way they approach learning and interact with students. From more structural to more creativity-oriented teachers, this variety of skills reflects individual diversity among educators.

An effective teacher must have good mastery of the subject matter being taught and also have skills in teaching (pedagogy). Mastery of material includes a deep understanding of concepts, facts, principles, laws and theories related to the subject being taught (Asmawati & Bintang Kejora, 2020). According to Article 10 of Law Number 14 of 2005, the concept of pedagogy refers to the ability to organize and manage students' learning processes. This learning process is not only limited to formal and academic contexts but also includes aspects of character and social education for students (Onishchuk et al., 2020).

Teacher pedagogical skills are a crucial element in efforts to improve the quality of learning. Teachers who have superior pedagogical skills can create learning environments that are engaging, effective, and focused on student needs (Archambault, Leary, & Rice, 2022). However, many teachers still have not fully acquired adequate pedagogical skills. This indicates the need for more attention to developing teachers' pedagogical skills so that each learning process can run optimally and meet students' learning needs better.

Previous research by Negassa&Engdasew (2017) shows that training in pedagogical skills affects how teachers utilize lesson planning, active learning techniques, continuous assessment methods, and classroom management. Teachers highlighted the beneficial effects of such training on their teaching practices while also noting challenges such as redundant concepts, activities, and examples, modules that fail to meet standards, lengthy training sessions, large class sizes, inadequate materials and facilities, lack of motivation, and difficulties in fully implementing what they learned from the training.

Another study by Guillén-Gámez et al. (2021) shows that the research findings indicate a notable contrast in the utilization and familiarity with 2.0 tools and Moodle Modules. Moreover, it was found that age and gender play a role in forecasting the extent of digital pedagogical competence among educators, whereas the educational level they teach at does not impact it. These conclusions derived from the study could aid in crafting educational interventions aimed at enhancing the digital proficiency of less skilled educators.

The novelty of this research comes from the research object, namely strategies for improving teachers' pedagogical skills in science learning, which have never been researched before. This research can assist in the development of theories and frameworks for more effective and innovative science education. In addition, these findings can also contribute to the

literature on teacher professional development and scientific subject learning. This research aims to develop effective strategies to improve teachers' pedagogical skills in science learning.

## RESEARCH METHODS

This study employs both qualitative and quantitative research techniques, commonly referred to as mixed methods. Mixed methods research integrates qualitative and quantitative components in a single study, enabling researchers to comprehensively comprehend the subject matter more through the fusion of diverse data types (Bertrand, Ross, Sullivan, Hardee, & Shelton, 2020). Mixed methods can be used to explore the complexity of a problem, understand the various dimensions of the phenomenon under study, and confirm and expand the findings of each approach (Stern et al., 2021).

The population in this study consisted of science teachers at state junior high schools in Bandung Regency. The sampling technique in this research is convenience sampling. Convenience sampling is a sampling method in which researchers select subjects or sample units based on availability and ease of access (Stratton, 2021). Based on this, the sample for this research was 100 science teachers. This research uses three data collection techniques: literature study, observation and questionnaires. Literature studies collect information from various literature sources related to the research topic. Observations are carried out directly to observe the phenomena being studied in the field.

Meanwhile, questionnaires are used to collect data from respondents through written questions. After the data was collected, analysis was carried out in two ways. Qualitative data undergoes analysis in three phases: data reduction, which involves refining and organizing the data, data presentation for clarity and comprehension, and drawing conclusions to interpret the findings. Meanwhile, quantitative data is analyzed descriptively, which includes presenting and interpreting data statistically to describe and explain the characteristics of the sample studied.

## RESULTS

### Validity test

Validity testing is evaluating the extent to which a measurement instrument (such as a questionnaire or test) can measure what it is supposed to measure. Validity measures the extent to which the instrument actually measures the variable or construct in question and not other variables (Bernstein, Resch, Ovsiew, & Soble, 2021).

**Table 1. Validity Test Results**

		X1	X2	X3	X4	X5	X6	Y
X1	Pearson	1	,571*	,488*	.437*	,488*	.437*	.226*
	Correlation		*	*	*	*	*	
	Sig. (2-tailed)		<.001	<.001	<.001	<.001	<.001	.024

## Strategies To Improve Teachers' Pedagogical Skills in Science Learning

	N	100	100	100	100	100	100	100
X2	Pearson	,571*	1	,632*	,622*	,632*	,622*	,494*
	Correlation	*		*	*	*	*	*
	Sig. (2-tailed)	<.001		<.001	<.001	<.001	<.001	<.001
	N	100	100	100	100	100	100	100
X3	Pearson	,488*	,632*	1	,573*	1,000	,573*	,450*
	Correlation	*	*		*	**	*	*
	Sig. (2-tailed)	<.001	<.001		<.001	<.001	<.001	<.001
	N	100	100	100	100	100	100	100
X4	Pearson	.437*	,622*	,573*	1	,573*	1,000	.328*
	Correlation	*	*	*		*	**	*
	Sig. (2-tailed)	<.001	<.001	<.001		<.001	<.001	<.001
	N	100	100	100	100	100	100	100
X5	Pearson	,488*	,632*	1,000	,573*	1	,573*	,450*
	Correlation	*	*	**	*		*	*
	Sig. (2-tailed)	<.001	<.001	<.001	<.001		<.001	<.001
	N	100	100	100	100	100	100	100
X6	Pearson	.437*	,622*	,573*	1,000	,573*	1	.328*
	Correlation	*	*	*	**	*		*
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001		<.001
	N	100	100	100	100	100	100	100
Y	Pearson	.226*	,494*	,450*	.328*	,450*	.328*	1
	Correlation		*	*	*	*	*	
	Sig. (2-tailed)	.024	<.001	<.001	<.001	<.001	<.001	
	N	100	100	100	100	100	100	100

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

\* . Correlation is significant at the 0.05 level (2-tailed).

Based on the information contained in Table 1, it can be seen that each measuring instrument shows the significance value (2-tailed) of the correlation for all items below 0.05. Thus, it can be concluded that all the statements in the questionnaire are considered statistically valid, and the questionnaire can be considered a valid instrument for use in this research.

### Reliability Test

The reliability index indicates the extent to which a measuring instrument can be considered trustworthy or dependable (Pribble, Black, Larson, & Larson, 2021). A perfect reliability is achieved when alpha is greater than 0.90. High reliability is indicated when alpha falls between 0.70 and 0.90. Moderate reliability is suggested when alpha ranges from 0.50 to

0.70. Reliability is considered low when alpha is less than 0.50, indicating that one or more items are likely unreliable.

**Table 2. Reliability Test Results**

Cronbach's Alpha	N of Items
,877	7

According to the findings presented in Table 2, the reliability test demonstrates a Cronbach Alpha value of 0.808, surpassing the threshold of 0.600. Consequently, it can be concluded that the questionnaire exhibits a commendable level of consistency and reliability, warranting its suitability for further research endeavors.

**Normality test**

As per Aslam (2019), the Kolmogorov-Smirnov test is deemed more suitable for sample sizes exceeding 50. Hence, researchers opted for the Kolmogorov-Smirnov test due to the sample size being greater than 50. Presented below are the outcomes of the normality assessment.

**Table 3. Normality Test Results**

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic			Statistic		
	s	df	Sig.	s	df	Sig.
X1	,191	100	<.001	,877	100	<.001
X2	.141	100	<.001	,936	100	<.001
X3	.135	100	<.001	,935	100	<.001
X4	,176	100	<.001	,901	100	<.001
X5	.135	100	<.001	,935	100	<.001
X6	,176	100	<.001	,901	100	<.001
Y	.137	100	<.001	,930	100	<.001

a. Lilliefors Significance Correction

Based on Table 3, the results of the normality test with Kolmogorov-Smirnov for the variables of developing teacher competence (X1), increasing competition in content and learning methods (X2), skills in using technology as a learning aid (X3), skills in managing interactions with students and other parties. Others (X4) and teacher pedagogy. (Y) obtained sig. 0.001, so it can be concluded that the four data are normally distributed.

**Regression Test**

Regression analysis/test studies the relationship between one variable, namely the explained variable, and one or more variables (Campbell, 2023).

**Table 4. Regression Test Results**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	194,051	4	48,513	9,587	<.001b
	Residual	480,709	95	5,060		
	Total	674,760	99			

a. Dependent Variable: Y  
b. Predictors: (Constant), X6, X1, X5, X2

Based on Table 4, the regression test results show a significance value of  $0.000 < 0.05$ , which means that all independent variables have a positive and significant effect on educator pedagogy.

### Discussion

#### The Influence of Educator Competency Development on Teacher Pedagogy

Based on the research results, it was found that the development of educator competence influences teacher pedagogy. The first strategy to improve teachers' pedagogical skills in science learning is to develop educator competence. This is because it is not enough for a teacher to only rely on knowledge obtained during lectures or previous experience in the world of teaching at school. On the other hand, what is very important in the world of education is a teacher's responsibility to respond to changes that occur quickly. A teacher also needs practice to develop his abilities. Mastery of teaching material alone is not enough for teachers if it is not supported by mastery of how the delivery of teaching material can be understood by students (Goksoy, 2018).

Teaching and learning processes must constantly overcome obstacles imposed by rapid scientific and technological progress and changes in student profiles and access to information (Nasre-Nasser, Oliveira, Marques Ribeiro, & Arbo, 2022). Increasing students' interactions with classmates can enhance learning, and the classroom is a natural place for these interactions to occur (Prober & Norden, 2021).

The importance of efforts to develop pedagogical competence to improve the quality of the learning process in schools, especially for teachers, can be realized through training or workshops. Training for teachers is a form of teaching carried out by educational experts to increase the professionalism and effectiveness of learning activities in the classroom. This training involves aspects ranging from teaching planning techniques to strategies for improving the quality of learning. In training and workshops that focus on science pedagogy, various aspects can be emphasized, such as applying innovative learning strategies, effective classroom management, and using authentic assessment. Teachers can gain new skills and understanding in designing and delivering science learning materials through this activity more effectively.

Apart from training and workshops, developing teacher competency can be done by forming a learning community between science teachers to share experiences. One form is through Class Action Research (PTK). PTK is a professional development model where teachers pay attention to the way students learn to the teaching methods used so that teachers can identify and correct deficiencies in their teaching methods, which in turn has an impact on improving the student learning process. Classroom Action Research can improve teachers' ability to self-reflect, improve school quality, and form a professional culture among educators.

### **The Effect of Increasing Competition in Content and Learning Methods on Teacher Pedagogy**

Based on the research results, it was found that increasing competence in content and learning methods affected teacher pedagogy. The next strategy to improve teachers' pedagogical skills in science learning is through developing content and learning methods. Given the current conditions, teachers must explore their creativity to make learning more interesting and attract students' interest. In this case, teachers can use methods and content to support learning activities. Learning methods refer to the ways of presenting subject matter carried out by educators to create a learning process for students to achieve a level of learning success. The success of this learning then becomes the main goal of the learning process. Learning methods play a role as support and enablers that support the effectiveness of the learning process, increase interest in learning, and make it easier for students to understand the material, ultimately resulting in students getting satisfactory learning results (Zhu, Li, Wu, Dong, & Shi, 2020).

Utilizing technology in education holds promise for fostering inclusivity among students. As technological advancements continue, the significance of digital literacy in educational institutions has prompted the issuance of numerous documents detailing strategies for establishing a more inclusive learning environment (Pagliara & Utge, 2023). Effective lesson planning is integral to teaching across all subjects within schools (Cevikbas, Koenig, & Rothland, 2024). When crafting lesson plans, educators must ensure readiness in implementing various teaching methodologies.

This means that choosing the right learning method can make it easier to achieve the expected goals. To improve student learning outcomes, a teacher needs to have a deep understanding of the material to be presented, as well as expertise in managing and using learning methods appropriately. Choosing the right learning method must be adjusted to the relevant curriculum, which includes preparing the science curriculum according to student needs and keeping up with current developments. As a result, teachers can create an effective learning environment that meets the curriculum demands and students' developmental needs.

As for content development, teachers can carry out interactive content, where students are actively involved in the learning process. Interactive content is content in which students actively participate in learning activities, so students don't just hear, see, or read. The advantages of interactive content include being able to attract students' attention and interest

in learning, enabling the development of students' five senses, increasing the effectiveness of learning, providing flexibility in implementing learning in various places and times, and improving students' learning attitudes (Winarto, Syahid, & Saguni, 2020). The positive impact is that teachers can create a more dynamic learning experience, with active participation from students, encouraging critical thinking and strengthening student involvement in the learning process.

### **The Influence of Skills in Using Technology as a Learning Aid on Teacher Pedagogy**

Based on the research results, it was found that skills in using technology as a learning aid influence teacher pedagogy. The next strategy is that teachers can use technological advances to improve their pedagogical skills because, along with the new implementation, every teacher is expected to have knowledge and skills in utilizing Information and Communication Technology (ICT) in learning activities. Teachers need to improve their professionalism, including mental aspects, commitment, and quality, so they can have competence that aligns with the development of the Industrial Revolution.

The Industrial Revolution required teachers to optimize information technology advances quickly to improve the quality of the teaching and learning process and create superior human resources. Teachers should have understood and skills in using computer programs to improve the quality of teaching and learning in the era of globalization. This aims to utilize available technology and facilitate the teaching process. Teachers are also expected to be able to use equipment that is more economical, efficient and following what is available at the school. Apart from that, teachers should not refuse to use modern technological equipment that is relevant to the demands of society and current developments.

Teachers who integrate Information and Communication Technology (ICT) in their subject-learning activities at school can make the learning process more interesting and help students understand the material more optimally. This ultimately contributes to improving the quality of student learning outcomes. The level of information and communication technology (ICT) literacy is an obligation for teachers not to be left behind with student development. Mastery of ICT literacy is an important basis for teachers to have to create students who are ready to compete in facing the current industrial revolution (Gnambs, 2021).

As a concrete example of the application of ICT literacy in learning, teachers can utilize educational applications, online learning platforms and social media. Teachers can use relevant educational applications to enrich science learning materials, present virtual experiments, or provide simulations that support understanding of scientific concepts. Online learning platforms can assign assignments, provide additional learning resources, and facilitate discussions between students. Utilizing social media, teachers can create learning communities outside of class hours, share the latest information about scientific developments, or stimulate discussion and collaboration between students. In this way, science teachers not only follow technological developments but also actively use various ICT tools to improve the quality of

learning, support the exploration of scientific concepts, and increase student involvement and understanding in science subjects.

### **The Influence of Skills in Managing Interactions with Students and Other Parties on Teacher Pedagogy**

Based on the research results, it was found that skills in managing interactions with students and other parties influence teacher pedagogy. The following strategy is to manage interactions with other parties to improve teacher pedagogical skills. First, interaction between teachers and students plays a vital role in teaching and learning activities at school. The teaching and learning process in schools involves interconnected elements, namely, students as those who learn, teachers as those who teach, and schools as organizers of formal education programs. The teaching and learning process is the core of formal education in schools, and in this dynamic, interactions and reciprocal relationships occur between students and teachers. Students receive learning materials taught by the teacher, while the teacher teaches by stimulating, guiding, and directing students to study the learning materials following the stated objectives (Sondakh et al., 2021).

Through this interaction concept, teachers must have two basic assets: the ability to design programs and the skills to communicate the program to students. In this understanding, it is the teacher who teaches and the students who learn. The close relationship between the two is very important so that the message conveyed by the teacher, especially in science learning material, can be understood well by students. Apart from interacting with students, teachers are also expected to have the ability to communicate effectively with parents and the community. The involvement of parents and the community is an important factor in supporting science learning, involving them in activities such as educational programs for parents, visits to scientific places, and science projects with the community. Therefore, teachers focus on interaction with students in the classroom and build positive collaboration with parents and the community to enrich the science learning experience.

### **The Influence of Competence in Controlling Interactions with the Development of Information Resources on Teacher Pedagogy**

The research findings indicate that proficiency in managing interactions with information resources development impacts teacher pedagogy. A subsequent approach involves the capability to oversee the advancement of educational materials and access to them, driven by advancements in science and technology prompting schools to equip and enhance teaching resources for educators during the instructional process. Learning resources encompass a wide array of elements such as materials, data, concepts, individuals, etc., facilitating the learning journey. These may include textbooks, modules, student worksheets, tangible objects, simulations, markets, banks, museums, zoos, among others. Thus, it can be inferred that learning resources encompass diverse sources including data, individuals, methodologies, media, and locations utilized by students to facilitate the learning process.

Duffy and Jonassen stated that using various learning resources is an effort to overcome learning problems. According to Percival and Ellington, of the various learning resources available, textbooks are the only learning source used apart from direct teaching efforts by teachers.

### **The Effect of Access to Learning Resources and Information on Teacher Pedagogy**

According to the research findings, proficiency in managing interactions with the evolution of information resources significantly impacts teacher pedagogy. Moreover, Supriadi's study elucidates that learning resources extend beyond traditional printed materials like textbooks. Students have access to a plethora of alternative resources, including educational radio, television, computers, email, interactive video, satellite communications, and multimedia technology. The diversification of learning resources aims to enhance interaction and streamline student feedback. Consequently, teachers are urged to explore additional, pertinent learning resources, particularly in scientific subjects, to bolster the learning journey.

Then, apart from using various learning resources, teachers must also ensure that students have adequate access to various learning resources such as libraries, laboratories, and the Internet. The aim is so that students can make optimal use of it in the learning process. This approach emphasizes that learning not only depends on textbooks as the only source but also involves expanding coverage by utilizing technology and developing learning resources appropriate to current developments.

The 21st century is marked by rapid progress in science and technology, especially in the field of information and communication technology, which plays an important role in society's life. These developments not only reflect major shifts in the way people interact, work, and access information but also illustrate fundamental shifts in learning paradigms. Students are no longer only expected to have expertise in science but are also required to have skills in using technology, be literate individuals, and have good morals. Students are an important asset for the progress of a nation. A nation is advanced if it contains quality human resources (Vrontis et al., 2022).

Referring to this statement suggests that education is faced with increasingly difficult challenges, one of which is that education should be able to produce human resources who have complete abilities to face various challenges in life. This means that education must be able to produce human resources with academic knowledge and in-depth knowledge, technological skills, literacy, and good morality needed to face the dynamics of an ever-developing era.

One of the factors that supports the success or failure of education and learning in school is largely determined by the role of the teacher. The success of a nation's education is largely determined by the approach used by educators or teachers in delivering the material to students. Teachers act not only as transmitters of information but also as learning managers.

They act as facilitators who strive to create an effective learning environment. Teachers' approach in delivering material has an important role, considering that it can influence students' level of understanding and interest in learning. Teachers are also expected to be able to develop learning materials well, ensuring that the material presented is relevant and easy for students to understand. In addition, the teacher's role as a learning manager involves improving students' ability to listen to lessons and achieve the educational goals that have been set.

Teachers are the main component in the learning process at school, and they determine students' success (Sudargini & Purwanto, 2020). This means that students' learning success is largely determined by the role and quality of the teacher's work in providing teaching. The role of the teacher is not only as a transmitter of information but also as the main driver in shaping the quality of education and student achievement. That is why every evaluation of education, especially the curriculum and improvement of human resources resulting from educational efforts, always boils down to the teacher factor. This reflects the importance of understanding and improving teachers' teaching skills to achieve educational success.

As per Regulation No. 16 of 2007 issued by the Minister of National Education of the Republic of Indonesia regarding Academic Qualification Standards and Teacher Competencies, there are four primary competencies essential for teachers: pedagogical competence, personality competence, social competence, and professional competence. These competencies are interwoven into a teacher's performance, with pedagogical competency as a fundamental differentiator between teachers and other professions. Pedagogical competence is central to a teacher's effectiveness, echoing Shulman's perspective, which emphasizes its inclusion as foundational knowledge for teachers. Defined as the ability to orchestrate student learning, pedagogical competence encompasses various sub-competencies, as outlined by Risan (2022).

1. Understand the physical, social, moral, cultural, emotional, and intellectual characteristics of students.
2. Understanding the family and community background of students, as well as learning needs under the context of cultural diversity.
3. Understanding students' learning styles and learning difficulties.
4. Facilitate the development of students' potential.
5. Mastering the theories and principles of learning and educational learning.
6. Developing a curriculum to encourage student involvement in learning.
7. Designing educational learning.
8. Carrying out educational learning.
9. Evaluate learning processes and outcomes.

Based on these sub-competencies, pedagogical skills include several knowledge and skills that support teachers in effectively learning and following students' needs in various subjects, including Natural Sciences (Science). At the elementary school level, natural science or science is one of the subjects that play an important role in education because science can be a provision for students facing various challenges in the global era (Winarni, Hambali, & Purwandari, 2020).

IPA is an abbreviation for Natural Sciences, covering various fields of science such as Physics, Chemistry, and Biology. Science subjects at school are a branch of science that seeks to find answers to various natural phenomena. In science learning, students can develop an understanding of scientific concepts, improve critical thinking skills, and build a base of knowledge relevant to the surrounding environment. Science learning materials include basic concepts, approaches, methods, and scientific analysis techniques to study various phenomena and problems in people's daily lives. Even so, science subjects are considered difficult for students to understand, which can reduce their interest in studying them.

The level of learning mastery in studying science is generally reflected in learning achievement, which is measured in the form of grades. Lack of mastery of science concepts often results in low grades. According to Khoir, as quoted by (Sukma, Ramadhan, & Indriyani, 2020), difficulties in learning science at the elementary school level are caused by several factors, including too many foreign terms, material that is too dense, students' tendency to memorize material without understanding, limited learning media, teacher dominance. In learning, lack of mastery of the material by the teacher, and lack of variety in delivering the material. If not addressed quickly, these emerging challenges can have long-term impacts on student development. To overcome these challenges, teachers are required to have good pedagogical skills. Therefore, effective strategies are needed to improve teachers' pedagogical skills in science learning.

The results of research by implementing strategies such as developing teacher competencies, developing learning content and methods, the ability to utilize technological advances, the ability to manage interactions with other parties and the ability to manage the development of learning resources and access to learning resources can improve teachers' pedagogical abilities in science learning. These strategies are expected to overcome the challenges teachers face, including increasing student motivation and learning achievement, which can be measured through grades, and the broad scope of these strategies is expected to produce graduates who become superior human resources.

### **CONCLUSION**

The research results confirm that there are several effective strategies in improving teachers' pedagogical skills in science learning. One of them is developing educator competence, which includes a deep understanding of the subject matter and the ability to

design and implement appropriate learning strategies. Additionally, increasing competence in learning content and methods is also an important factor, including understanding innovative and effective learning approaches. The use of technology is also considered an effective strategy, where teachers must be able to utilize technology as a tool in the learning process. Furthermore, skills in managing interactions with students and other parties were also an influencing factor, including building good relationships with students and collaborating with colleagues and other related parties. Finally, adequate access to information resources and learning resources is also an important factor in improving teachers' pedagogical skills in science learning. These strategies have been proven to significantly improve teachers' pedagogical skills in science learning, as indicated by a significance value that is lower than the specified significance limit.

## BIBLIOGRAPHY

- Archambault, Leanna, Leary, Heather, & Rice, Kerry. (2022). Pillars of online pedagogy: A framework for teaching in online learning environments. *Educational Psychologist*, 57(3), 178–191.
- Asmawati, Erni, & Bintang Kejora, M. T. (2020). The effect of using simple aircraft concrete media on the mastery of concepts in inquiry science learning in elementary school students. *MUDARRISA: Jurnal Kajian Pendidikan Islam*, 12(2), 150–168.
- Bangun, Cicilia Sreliasta, Purnama, Suryari, & Panjaitan, Aropria Saulina. (2022). Analysis of new business opportunities from online informal education mediamorphosis through digital platforms. *International Transactions on Education Technology*, 1(1), 42–52.
- Bernstein, Matthew T., Resch, Zachary J., Ovsiew, Gabriel P., & Soble, Jason R. (2021). A systematic review and meta-analysis of the diagnostic accuracy of the advanced clinical solutions word choice test as a performance validity test. *Neuropsychology Review*, 31(2), 349–359.
- Bertrand, Jane T., Ross, John, Sullivan, Tara M., Hardee, Karen, & Shelton, James D. (2020). Contraceptive method mix: updates and implications. *Global Health: Science and Practice*, 8(4), 666–679.
- Campbell, Harlan. (2023). Equivalence testing for linear regression. *Psychological Methods*.
- Cevikbas, Mustafa, Koenig, Johannes, & Rothland, Martin. (2024). Empirical research on teacher competence in mathematics lesson planning: Recent developments. *ZDM—Mathematics Education*, 56(1), 101–113.
- Gnams, Timo. (2021). The development of gender differences in information and communication technology (ICT) literacy in middle adolescence. *Computers in Human Behavior*, 114, 106533.
- Goksoy, Suleyman. (2018). Teacher views on the applicability of mastery learning model in teaching learning process. *Eurasian Journal of Educational Research*, 18(78), 203–218.
- Magfiroh, Andi Anis, Irfan, Muflih Naufal, Rahmat, Rahmat, & Ruhaya, Besse. (2023). Formal, Non-formal, and Informal Islamic Education Institutions and Islamic Education Figures in Indonesia. *Journal of Indonesian Islamic Studies*, 2(2), 46–60.
- Nasre-Nasser, Raif Gregorio, Oliveira, Gislaine Alves de, Marques Ribeiro, Maria Flavia, & Arbo,

- Bruno Dutra. (2022). Behind teaching-learning strategies in physiology: perceptions of students and teachers of Brazilian medical courses. *Advances in Physiology Education*, 46(1), 98–108.
- Onishchuk, Iryna, Ikonnikova, Maryna, Antonenko, Tetiana, Kharchenko, Inna, Shestakova, Svetlana, Kuzmenko, Nataliia, & Maksymchuk, Borys. (2020). Characteristics of foreign language education in foreign countries and ways of applying foreign experience in pedagogical universities of Ukraine. *Revista Romaneasca Pentru Educatie Multidimensionala*, 12(3), 44–65.
- Pagliara, Silvio Marcello, & Utge, Marta Sanchez. (2023). Tool for Digital Inclusion in Italian Schools: The Use of Self-Assessment Framework from ENTELIS Project. *Assistive Technology: Shaping a Sustainable and Inclusive World*, 306, 455.
- Pribble, Brian A., Black, Christopher D., Larson, Daniel J., & Larson, Rebecca D. (2021). An evaluation of the reliability of the foot-tapping test in a healthy sample. *The Foot*, 48, 101851.
- Prober, Charles G., & Norden, Justin G. (2021). Learning alone or learning together: is it time to reevaluate teacher and learner responsibilities? *Academic Medicine*, 96(2), 170–172.
- Sondakh, Daniel Stefanus Imanuel, Rahmatullah, Azam Syukur, Adiyono, Adiyono, Hamzah, Muh, Riwayatningsih, Rika, & Kholifah, Nanik. (2021). Integration of language, psychology, and technology and the concept of independence learning in reading characters in Indonesian children's films as media and learning materials in character building for elementary school students-Indonesia. *LinCure: Linguistics and Culture Review*, 6(1), 70–88.
- Stern, Cindy, Lizarondo, Lucylynn, Carrier, Judith, Godfrey, Christina, Rieger, Kendra, Salmond, Susan, Apóstolo, João, Kirkpatrick, Pamela, & Loveday, Heather. (2021). Methodological guidance for the conduct of mixed methods systematic reviews. *JBIM Evidence Implementation*, 19(2), 120–129.
- Stratton, Samuel J. (2021). Population research: convenience sampling strategies. *Prehospital and Disaster Medicine*, 36(4), 373–374.
- Sudargini, Yuli, & Purwanto, Agus. (2020). The effect of teachers pedagogic competency on the learning outcomes of students. *Journal of Industrial Engineering & Management Research*, 1(4), 1–8.
- Sukma, Elfia, Ramadhan, Syahrul, & Indriyani, Vivi. (2020). Integration of environmental education in elementary schools. *Journal of Physics: Conference Series*, 1481(1), 12136. IOP Publishing.
- Vrontis, Demetris, Christofi, Michael, Pereira, Vijay, Tarba, Shlomo, Makrides, Anna, & Trichina, Eleni. (2022). Artificial intelligence, robotics, advanced technologies and human resource management: a systematic review. *The International Journal of Human Resource Management*, 33(6), 1237–1266.
- Winarni, Endang Widi, Hambali, Daimun, & Purwandari, Endina Putri. (2020). Analysis of Language and Scientific Literacy Skills for 4th Grade Elementary School Students through Discovery Learning and ICT Media. *International Journal of Instruction*, 13(2), 213–222.
- Winarto, Winarto, Syahid, Ahmad, & Saguni, Fatimah. (2020). Effectiveness the use of audio visual media in teaching Islamic religious education. *International Journal of Contemporary Islamic Education*, 2(1), 81–107.

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Zhu, Hancheng, Li, Leida, Wu, Jinjian, Dong, Weisheng, & Shi, Guangming. (2020). MetalQA: Deep meta-learning for no-reference image quality assessment. *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 14143–14152.

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**First publication right:**

Asian Journal of Engineering, Social and Health (AJESH)

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