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Post-COVID-19 Trends in Elementary Science Education: Dominant Methods, Media, and Assessment Practices

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Abstract: This study aims to determine the trend of elementary/MI science learning in the post-COVID-19 pandemic era. The research used a survey design. Data collection methods included observation, interviews, and documentation. All instruments were tested for content validity and construct validity. Data triangulation was done by comparing and checking data obtained from information from parties who played a role in the research. After that, data analysis was carried out. Data analysis techniques used qualitative descriptive and quantitative descriptive analysis techniques. The study concluded that the post-COVID-19 SD/MI science learning trends lead to the following indicators including (1) the dominant learning method is lecture, (2) blackboards and markers are the dominant learning media, (3) student worksheets (LKS) are learning resources that are highly used by teachers, (4) assessment instruments used files/paper/written (5) oral tests are an assessment technique that is highly used by teachers, (6) cognitive assessment is the teachers' favorite in evaluations, (7) the realm of cognitive assessment in the majority is still oriented towards LOTS (Low Order Thinking Skills), namely understanding and remembering, and (8) aspects of discipline and responsibility are the main affective assessments that most teachers do. These findings imply that there is a need for more diverse and higher-order thinking skills (HOTS)-oriented teaching and assessment methods to enhance the overall quality of science education.

Keywords: trends, science learning, post-COVID-19

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Introduction

The COVID-19 pandemic has created a new learning pattern, which is online learning. It has both positive and negative effects. Various positive impacts include increasing skills in using technology-based media (Handayani & Jumadi, 2021), learning achievement (Atikah et al., 2021), independent attitude (Susanti & Ernawati, 2021), and flexibility in place and time for learning activities (Tartavulea et al., 2020). On the other hand, there are negative impacts, such as technical obstacles for educators (Astuti, 2021; Rigianti, 2020; Simbolon & Harahap, 2021) and students (Juhana, 2021; M. D. Lestari, 2020). However, the COVID pandemic also creates new habits, namely learning interactions using online media. It hopes that this habit (Tartavulea et al., 2020) will continue to be used, even though in the middle of the implementation of face-to-face learning.

Significant changes in science learning methods at elementary/MI level due to the COVID-19 pandemic have resulted in deep adaptations to online learning (Afriansyah, 2024; Kosiyaporn et al., 2023; P. Lestari & Machmudah, 2023; Ong et al., 2023; Samad & Ahmad, 2023). The pandemic forced

educators and learners to rely on technology in the teaching and learning process, changing the way materials were delivered and practicums were conducted. After the pandemic subsided and face-to-face learning resumed, an important question arose about the direction of science learning development: whether to return to pre-pandemic methods, continue using methods during the pandemic, or even develop new methods that integrate both.

Science is a subject in primary education units, which has changed in pattern during the COVID-19 pandemic. Practicum, as the soul of the science learning process, has almost been lost or deleted as the effect of the implementation of online learning, which science practicum during the COVID-19 pandemic is more oriented toward the environment around the home or place of living (Darmayanti et al., 2021). Some have replaced it with virtual practicum (Arsyad, 2020; Defianti et al., 2021; Suryaningsih et al., 2020). Even though virtual practicum can replace real practicum, it might not be completely replaced as it cannot directly interact with practicum tools and materials (Maksum & Saragih, 2020). The students' worksheets are important as a reference for students in conducting scientific investigation activities (Febriana & Purbayanti, 2022).

This research is a novelty because it focuses on trends in elementary/MI science learning after the COVID-19 pandemic, which has not been studied much before. Previous studies such as Darmayanti. Putu Laksmi et al. (2014) and Tartavulea et al. (2020) only focus on the impact of the COVID-19 pandemic on science learning but do not study how science learning can adapt and develop after the pandemic. This research will map how elementary/MI science learning can change and develop in the face of changes that occur due to the COVID-19 pandemic.

Seeing the existing phenomenon, this research aims to find out how the trend of elementary school science learning after the COVID-19 Pandemic. Does it lead to elementary school science learning like before the COVID-19 pandemic or does it follow the learning during the COVID-19 pandemic, or even form a new science learning character? This research will invite readers to see how learning trends occur after the COVID-19 pandemic. In addition, the results of this study are expected to contribute to the development of education in Indonesia, especially in elementary school science learning. The results of this study can be used as a consideration for educators in designing post-COVID-19 science learning as well as reference material for the government in formulating learning outcomes and curricula that will be enforced.

Methods

The research used a survey design. The population is all teachers of elementary/MI classes in Central Java who carry out science learning. The sample is selected using the cluster random sampling technique which is selected from several elementary/MI teachers in some districts in Central Java Province who carried out science learning. The respondents were 45 teachers of elementary/MI from 45 elementary/MI units in 17 regencies/cities in Central Java Province (see Figure 1).

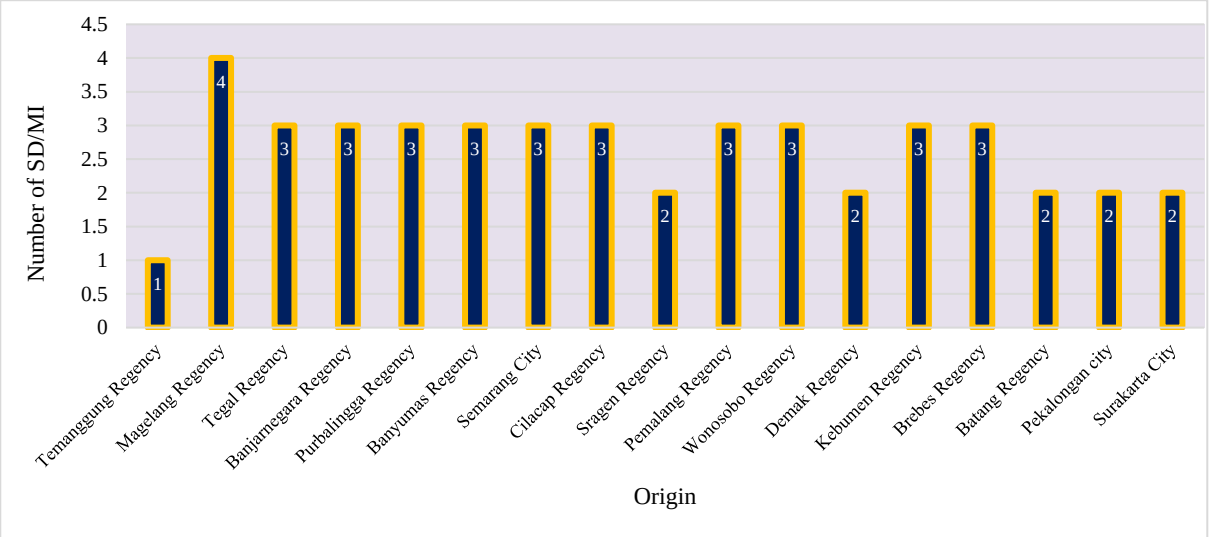

Figure 1. Distribution of Research Respondents from Each District/City

The respondents were Bachelor's and Master's graduates, 44 Bachelor's graduates, and 1 Master's graduate background. Based on educational background, 32 teachers have a background in Primary School Teacher Education (PGSD) or Madrasah Ibtidaiyah Teacher Education (PGMI). 11 teachers have educational backgrounds other than PGSD/PGMI. And, 2 teachers have non-educational science backgrounds.

All respondents have teaching experience, such as 1 year to more than 30 years. Table 1 presents the groups of respondents based on teaching experience to analyze the respondents from the perspective of teaching experience. At the distribution of individual data, the average teacher's teaching experience is 13.3 years, and the data distribution is shown in Figure 3.

Table 1. Respondents' Teaching Experience based on Group Data Distribution

Teaching Experience	Total Number (people)	Percentage (%)
1-5 years	12	26.7
6-10 years	6	13.3
11-15 years	7	15.6
16-20 years	14	31.1
21-25 years	2	4.4
26-30 years	1	2.2
More than 30 years	3	6.7
Total	45	100.0

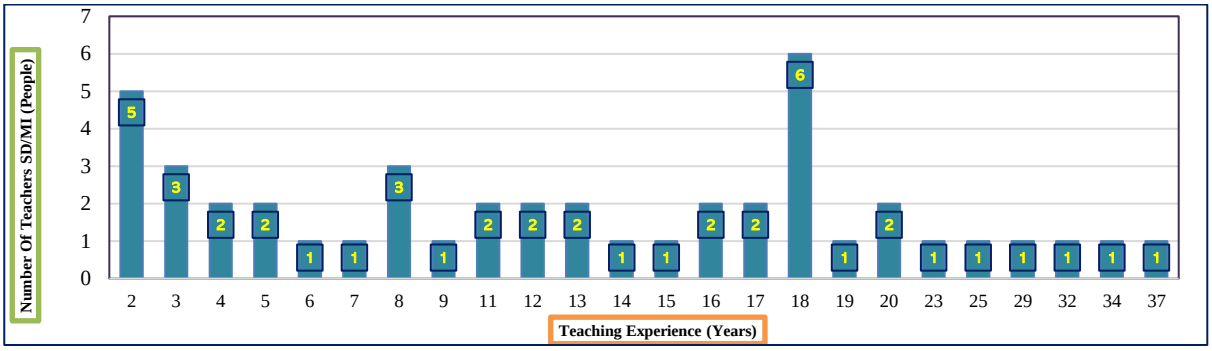

Figure 3. Respondents' Teaching Experience based on Individual Data Distribution

Based on Figure 3 and the average score, the majority of respondents have teaching experience under the average, which is 24 teachers with less than 13.3 years of teaching experience. On the ownership of teaching certificates, the majority of respondents, or 31 respondents had it. And, 13 respondents do not have it. This means that the majority of respondents are teachers who have professional criteria. Regarding the number of teachers' participation in training, the survey shows the majority of teachers have attended training from 1 time to 2 times. Data on the distribution of teachers' participation in training is presented in Table 2.

Table 2. Distribution of Teachers' Participation in Training

Number of training	Number of teachers
Never	6
1 - 2 times	12
3-4 times	9
5-6 times	9
7-8 times	1
More than 8 times	8

The research variable is the form of elementary/MI science learning patterns, seen from 3 aspects, planning, process, and learning evaluation. Learning planning is seen from the RPP (lesson plan) prepared by the teacher. Meanwhile, the implementation of science learning activity is seen from the learning process. And, evaluation of science learning is seen from the evaluation.

Data collection methods were observation, interviews, and documentation. Observations aim to observe the implementation of learning directly. Cameras are used during observations to visualize and

record the observation. Interviews were conducted to cross-check unclear things from observations using structured interview techniques. Documentation is used to record data in a document to obtain a complete picture of the condition of the document, including the expressed and implied things. The required document is a lesson plan. Research instruments consist of observation sheets and interview guideline sheets. The observation sheet contains ten things about science learning activities, starting from teaching preparation to evaluations. In detail, they are teaching preparation, apperception, learning methods, learning media, learning resources, assessment media, assessment techniques, assessment domains, student competency assessed in the cognitive domain, and student competency in the affective domain. The interview sheet contains questions to cross-check data from observation activities and documents.

All instruments were tested for content validity and construct validity. Content validity was carried out by creating an instrument guideline, developed from in-depth theoretical studies. Next, the instrument guideline was developed into indicators. Construct validity is carried out by asking for expert judgment to provide input or suggestions on the developing instrument through a Forum Group Discussion (FGD) by 4 experts in the field of science learning at the elementary/MI level and 2 elementary/MI teachers. Various suggestions and improvements from experts and practitioners were obtained and used as material for making improvements.

Data triangulation was carried out by comparing and checking data obtained from informants who have a role in the research. After that, it conducted a data analysis. The data of the research is qualitative and quantitative. The data analysis technique used qualitative descriptive and quantitative descriptive. Qualitative descriptive analysis is used to analyze data of notes from interviews and additional important events during observations. Meanwhile, quantitative descriptive analysis is used to analyze data from documentation and observation assessments. The results of documentation and observations are used to determine various patterns of science learning. Several identical patterns will be combined into one and calculated as a percentage. Then, it analyzed for the general pattern.

Results and Discussion

Result

The research aimed to determine trends in elementary/MI science learning after the COVID-19 pandemic. Learning trends are seen from ten things. They are teaching preparation, apperception, learning methods, learning media, learning resources, assessment media, assessment techniques, assessment domains, student competency assessed in the cognitive domain, and student competency in the affective domain. All these trends will be described in detail.

Teaching preparation is seen from the indicators (1) readiness of the lesson plan (RPP), (2) availability of classrooms and clean whiteboards, (3) availability of learning equipment, (4) readiness of learning media and students, and (5) suitability of learning materials and learning activities. Assessment of teaching readiness is seen from the achievement of indicators. The more indicators achieved, the better the teaching readiness. The results of the teaching readiness assessment are presented in Table 3.

Table 3. Results of Teaching Readiness Assessment

Achievement of Indicators	Frequency	Percentage
1	0	0
2	0	0
3	1	2.2
4	1	2.2
5	5	10.9
6	19	41.3
7	19	41.3

Based on Table 3, the majority of teachers already have good teaching readiness, as seen from the number of indicators achieved, which is at 6 and 7 indicators. Each of the indicators was achieved by 19 elementary/MI teachers.

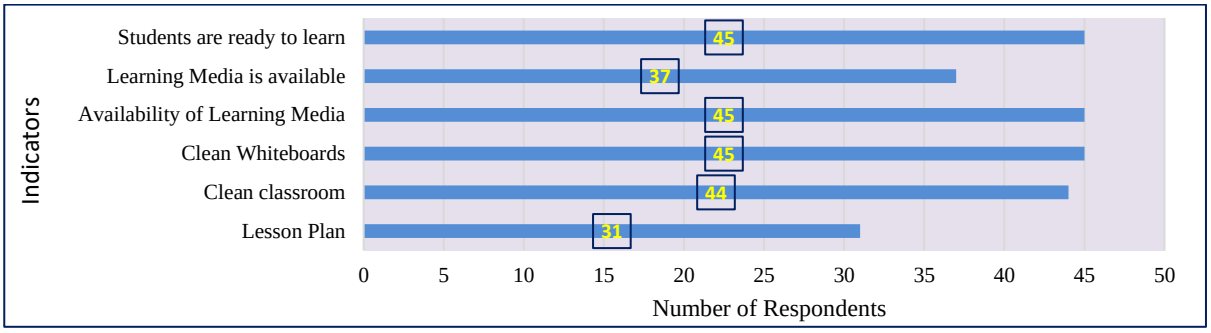

Figure 4. Components of Teaching Preparation

Apperception is included in five indicators, namely (1) conveying questions related to the ongoing material, (2) conveying the relationship between the previous meeting material and ongoing material, (3) conveying material or activities globally (outline), (4) conveying the planning activities, and (5) conveying motivation to become better by the teacher. The more indicators appeared, the better the apperception. The results of the respondents' apperception assessments are presented in Table 4.

Table 4. Assessments Results of Teacher apperception in Science Learning

Achievement of Indicators	Frequency
1.00	1
2.00	0
3.00	10
4.00	19
5.00	15

Table 4 shows the majority of teachers meet the achievement of implementing high apprehension, as seen from the number of teachers who obtained high scores, which are 19 people with a score of 4 and 15 people with a score of 5.

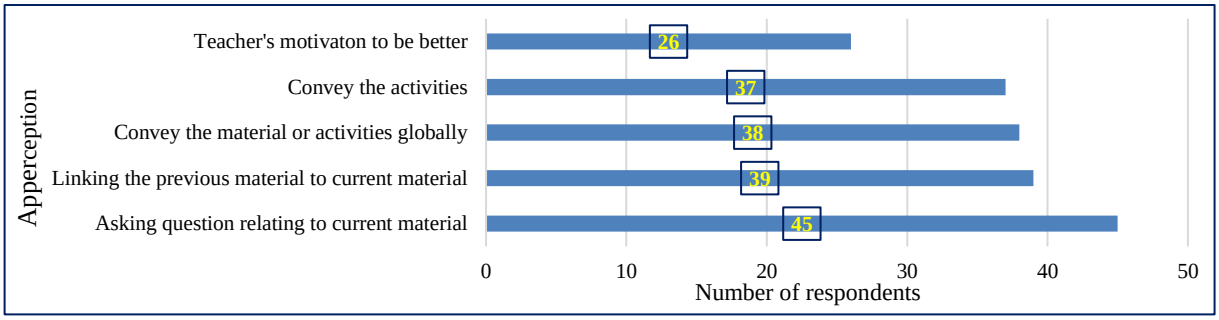

Figure 5. Apperception Activities

Learning methods consist of practical indicators, simulations or demonstrations, lectures, discussions, problem-based learning, cooperative learning, project-based learning, and other learning methods such as online learning. Table 5 shows the results of the learning methods.

Table 5. Learning Methods

Achievement of Indicators	Frequency	Percentage
1	2	4.3
2	16	34.8
3	11	23.9
4	8	17.4
5	5	10.9
6	1	2.2
7	2	4.3

Table 5 shows the majority of respondents gave a score of 2. It means that respondents only used a variety of 3 types of learning methods in learning

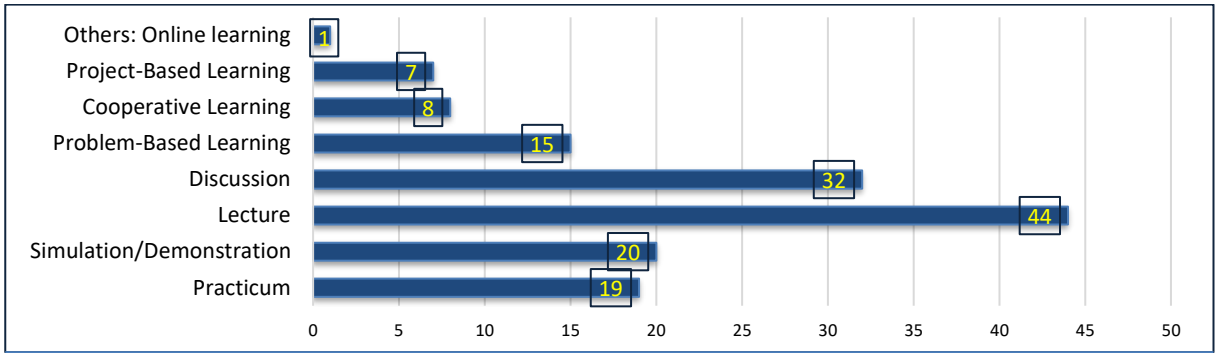

Figure 6. Various learning methods applied by respondents

This contains various learning media in learning, namely: WhatsApp/telegram/Google Classroom; Zoom/Google Meet, PowerPoint, learning videos, computer/notebook + LCD, whiteboard and marker/chalk, laboratory equipment, or other teaching aids. The result is presented in Table 6.

Table 6. The Use of Learning Media

Score	Number of Teachers
1	7
2	21
3	4
4	7
5	4
6	2
7	0
8	0

The research results showed that the majority of respondents used 2 variations of learning media. In contrast, only 2 respondents used more than 2 media variations in learning.

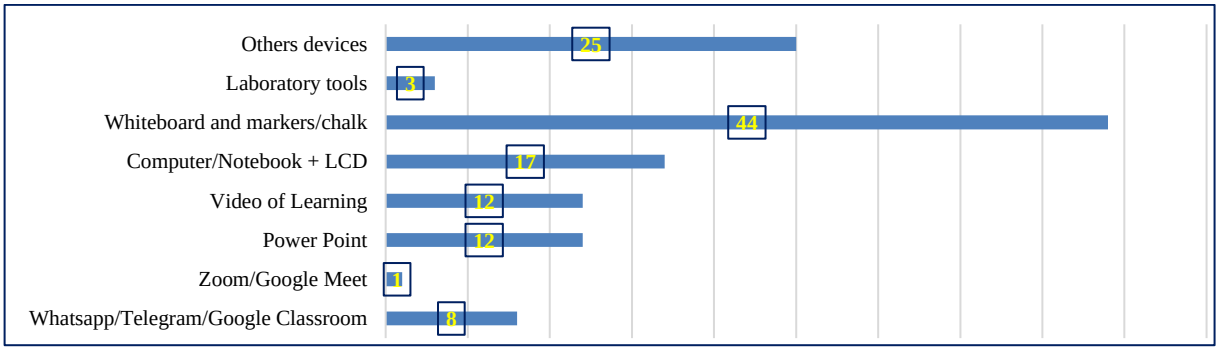

Figure 7. Various Learning Media Used by Respondents

Learning sources are seen from several types, such as student worksheets, modules, books, school environment, sources/informants (peers, community, teachers, other parties or institutions), internet, and/or social media, such as Instagram/Facebook/TikTok/etc. The number of learning sources used by respondents in learning is presented in Table 7.

Table 7. Learning Sources in Learning

Achievement of Indicators	Number of Teachers	Percentage
1	5	10.9
2	12	26.1
3	13	28.3
4	9	19.6
5	4	8.7
6	2	4.3

Table 7 shows the majority of respondents use 3 variations of learning sources in learning activities. In contrast, only 2 respondents used a variety of learning resources of up to 6 types.

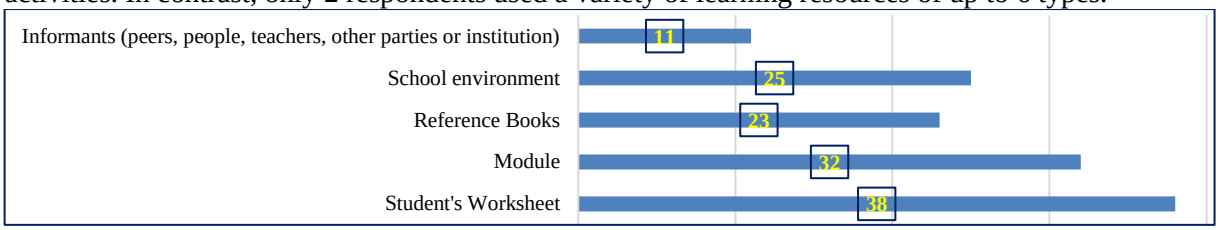

Figure 8. Learning Sources

Assessment media consists of Quizzes/Kahoot, Google Classroom, Google Form, and files/paper/written. The distribution of respondents who use assessment media is presented in Table 8.

Table 8. Use of Assessment Media

Score	Frequency	Percentage
0	4	8.7
1	35	76.1
2	3	6.5
3	3	6.5
4	0	0

Table 8 shows the majority of respondents only use one type of assessment media, which is files/paper/written. A small number of other respondents still use a variety of other assessment media of 3 to 4 different types of media.

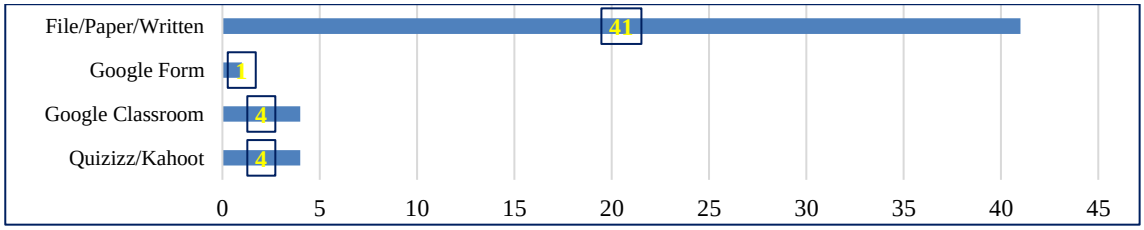

Figure 9. Assessment Media

Assessment techniques are assessed through several indicators, including written tests, oral tests, questionnaires, observation sheets, documentation, and structured assignments. Based on these indicators, Table 9 shows the results of the distribution of respondents using the assessment techniques (Table 9).

Table 9. Distribution of Respondents in Using Assessment Techniques

Achievement of Indicators	Frequency	Percentage
0	1	2.2
1	5	10.9
2	20	43.5
3	14	30.4
4	3	6.5
5	1	2.2
6	1	2.2

Table 9 shows the majority of respondents use 2 types of assessment techniques to support their learning activities. Moreover, it was still found the respondents used 5 to 6 types of assessment techniques. Some did not use any assessment techniques.

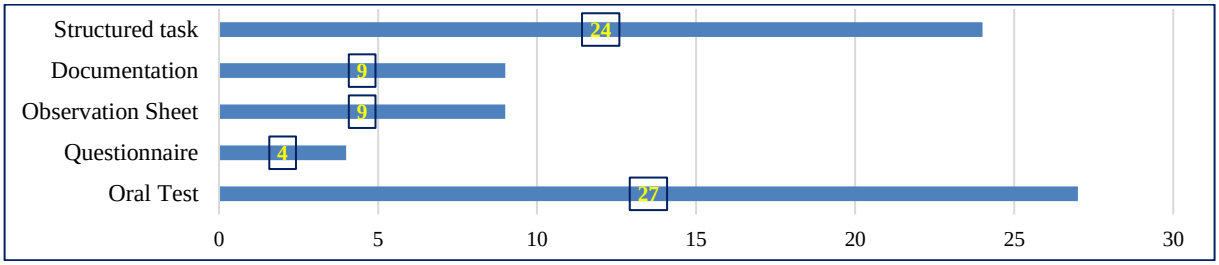

Figure 10. Assessment Techniques Applied

The assessment domain consists of cognitive, affective, and psychomotor. The distribution of respondents using assessments in this domain is presented in Table 10.

Table 10. Distribution of Respondents Based on the Domain

Achievement of Indicators	Frequency	Percentage
0	3	6.5
1	8	17.4
2	11	23.9
3	23	50.0

Based on the analysis, respondents carried out the most assessments in 3 domains with a total of 23 teachers. On the other hand, the lowest achievement occurred for 3 respondents.

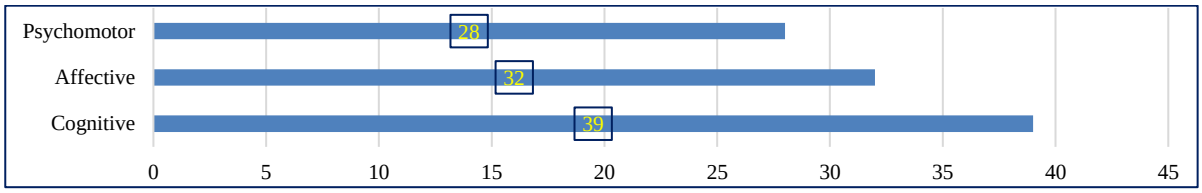

Figure 11. Measured Aspects of Assessment

The cognitive aspect assessment is measured by measuring competence in remembering, understanding, applying, analyzing, evaluating, and creating. The results are related to the implementation of assessments on cognitive aspects by respondents which is presented in Table 11.

Table 11. Distribution of Responses in Cognitive Aspect Assessments

Achievement of Indicators	Frequency	Percentage
1	0	0
2	2	4.3
3	14	30.4
4	14	30.4
5	11	23.9
6	4	8.7

Table 11 shows the majority of respondents carried out measurements of the achievement of cognitive aspects in 3 to 4 domains, which is 14 teachers. Only 2 respondents carried out cognitive assessments in 2 domains, which is 2 people.

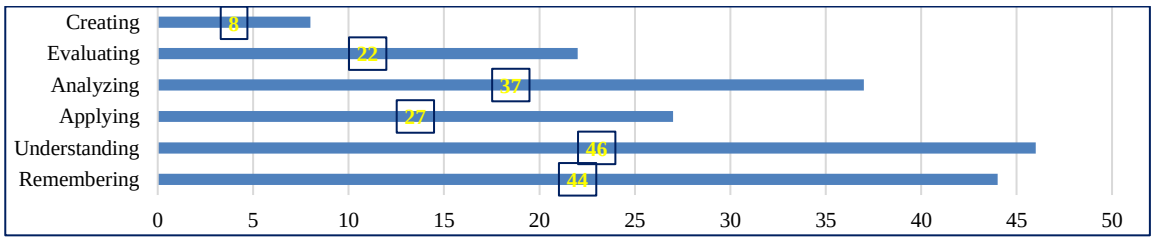

Figure 12. Assessment Domain

Based on Figure 12, most of the assessments are carried out by teachers in the areas of understanding and remembering. Meanwhile, the lowest domain of cognitive assessment is creating and evaluating. Teachers assess students' attitudes in the areas of discipline, responsibility, honesty, politeness, cooperation, thoroughness, and other aspects. And, the results of the assessment of respondents are presented in Table 12.

Table 12. Distribution of Respondents Who Carried Out Affective Aspect Assessments

Achievement of Indicators	Frequency	Percentage
1	0	0
2	1	2.2
3	9	19.6
4	6	13.0
5	11	23.9
6	16	34.8
7	2	4.3

Table 12 shows that respondents carried out the most assessments of affective aspects in 6 domains, which is 16 respondents. And, only one respondent carried out affective assessments in one domain.

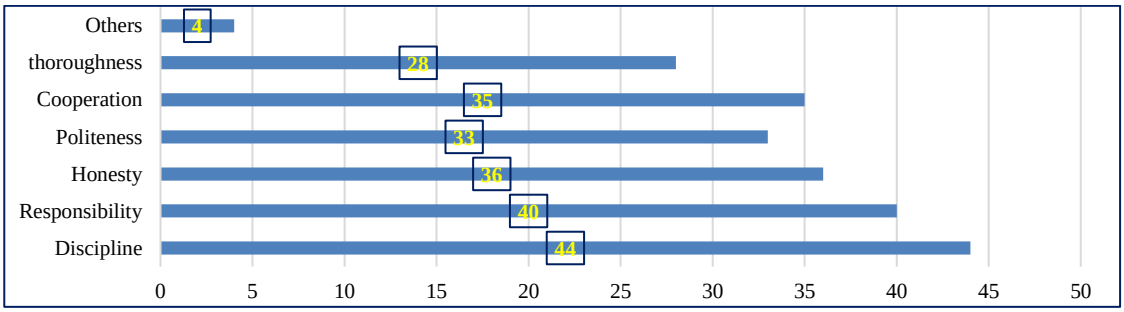

Figure 13. Affective Assessment

Figure 13 provides information the most often effective assessments carried out by teachers are discipline and responsibility. On the other hand, thoroughness is the lowest affective assessment carried out by teachers. Besides the research results, recorded through observation sheets, interview results show that most teachers are still making improvements to concepts in several materials because many students do not understand the material well. In fact, quite a few students experience misconceptions. Therefore, the transition period is used by teachers to improve concepts from the material during the pandemic. This misconception makes teachers choose the lecture method as a learning method in the new normal era with reason that they believe it is more effective in clarifying and explaining inaccurate concepts.

Discussion

Research on science learning in SD/MI in Central Java after the COVID-19 pandemic shows a preference for offline-based learning methods, with little use of online media. This trend is in line with the finding that the lecture method is the most widely used by teachers (Afrizal et al., 2022; Fardilah et al., 2022; Thomas, 2021), followed by group discussion, demonstration, practicum, problem-based, cooperative, and project-based learning (Blackburn & Stair, 2022; Shinvani et al., 2022). The use of online learning methods is the least used. The research revealed several challenges in online learning, including technological limitations, slow internet speeds, and lack of IT infrastructure, all of which hinder effective engagement between students and teachers with digital tools (El Mourabit et al., 2023; Tanjga, 2023). These challenges have affected students and teachers, causing difficulty in engaging with digital tools and maintaining motivation (Makruf & Tejaningsih, 2023; Malik & Derioh, 2023). While several educational institutions have tried to ensure continuity in education by offering reliable online learning platforms, the need for user-friendly and affordable e-learning platforms has been emphasized to overcome the obstacles in providing practical and experimental materials effectively during the

pandemic. Sajidan et al. (2021) argue that although online learning is helping in the COVID-19 crisis, its effectiveness in teaching science, which requires scientific process skills, is still low due to the dominance of text media and low student motivation.

Teaching Preparation

Teaching preparation is an important element in successful learning. Based on this research, the majority of teachers already have good teaching readiness, which is seen from the number of indicators achieved such as the readiness of lesson plans (RPP), the availability of clean classrooms and blackboards, the readiness of learning media and students, and the accuracy of learning materials with learning activities. The results showed that the majority of teachers achieved 6 to 7 indicators of teaching readiness. This study has shown that teacher readiness and professional experiential learning positively influence self-efficacy, with teacher readiness showing a stronger relationship. This underscores the importance of teacher readiness and experiential learning in enhancing self-efficacy, which ultimately contributes to effective teaching practices (S. Handayani et al., 2024; Kenesbekova et al., 2024; Pan, 2023).

Apperception

Effective apperception plays an important role in initiating a successful learning experience. The mentioned indicators of apperception, such as asking questions related to the material, connecting previous material to new content, outlining the material or activity, presenting the task, and teacher motivation, are essential to effectively engage students (Khaerati, 2016). Research shows that many teachers demonstrate proficiency in fulfilling these apperception indicators, as evidenced by the high scores received by a large number of teachers. Specifically, 19 teachers scored 4, and 15 teachers scored a perfect 5, demonstrating their ability to effectively deliver content, engage students, and maintain motivation in the classroom (Khaerati, 2016). This highlights the importance of effective teachers' perceived teaching behaviors and their observed effectiveness in creating a conducive learning environment for students throughout their educational journey (Looker et al., 2023).

Learning Methods

Research on science education in Indonesian elementary schools during and after the COVID-19 pandemic reveals a shift towards diverse teaching methods. These include online learning, practical work, simulations, lectures, discussions, problem-based learning, cooperative learning, and project-based learning (B & Ramli, 2021; Sufiyanto et al., 2022; Syaifulloh et al., 2023). While blended learning was generally well-received by students (Sufiyanto et al., 2022), challenges emerged such as limited internet access, inadequate parental support, and difficulties in conducting practical experiments remotely (B & Ramli, 2021; Hariani & Yulandariani, 2022). To address these issues, schools implemented various strategies, including home visits, simplified material delivery, and adherence to health protocols for limited face-to-face sessions (Hariani & Yulandariani, 2022). The use of diverse online platforms and media, such as Zoom, WhatsApp, Google Classroom, and educational games, became prevalent to facilitate remote learning (Hariani & Yulandariani, 2022; Syaifulloh et al., 2023).

Learning Media

The use of learning media in elementary science learning after the COVID-19 pandemic is limited to media, such as Whatsapp/Telegram/Google Classroom, Zoom/Google Meet, PowerPoint, learning videos, computers/notebooks + LCDs, whiteboards and markers/Kalk, laboratory equipment, or other teaching aids. This is similar to research by Azis and Febriana (2023) where 63% of schools use offline media such as whiteboards, computers, and laboratory equipment, while 37% of schools use a combination of offline and online media (Azis & Febriana, 2023). Online platforms such as WhatsApp, Google Classroom, and video conferencing are commonly used alongside traditional media (Syaifulloh et al., 2023). PowerPoint presentations and educational videos are popular choices among educators (Maharuli & Zulherman, 2021). WhatsApp groups are preferred by teachers and students due to ease of access and low data consumption (Aisyah & Kurniawan, 2021).

Assessment Media and Techniques

The assessment used in elementary science learning after the COVID-19 pandemic only uses one type of assessment media (file/paper/written), while a small number of others use a variety of assessment media up to four media. This is in line with research (Azis & Febriana, 2023), where assessment methods only relied on written evaluations, while other schools used up to four different assessment media. To overcome these challenges, schools should implement strategies such as limiting face-to-face classes, activating study groups, and improving teacher competencies through subject-specific training and forums (Hariani & Yulandariani, 2022; Manili et al., 2021).

Assessment domains

Assessment of the cognitive, affective, and psychomotor domains in elementary science learning after the COVID-19 pandemic shows that most teachers conduct assessments in three domains with a total of 23 teachers. Assessment of cognitive aspects includes measuring the competencies of remembering, understanding, applying, analyzing, evaluating, and creating. Assessment of affective aspects is carried out on discipline, responsibility, honesty, politeness, cooperation, accuracy, and other aspects. This is in accordance with research (Nduru, 2022; Nugraheni et al., 2021) which states that most teachers assess the cognitive domain which focuses on knowledge and understanding, while affective assessments examine discipline, responsibility, and cooperation.

The scientific contribution of this research provides important insights into the adaptation of learning methods in the post-COVID-19 pandemic, especially in the Central Java province. These findings can be used as a basis for the development of more effective and adaptive learning strategies in the future, with consideration of the specific challenges and needs of science learning at the elementary level.

Conclusion

This study intended to find an elementary science education (SD/MI) trend in the post-COVID-19 era. This study concludes that lecture is still the most frequently used teaching method based to survey design. White boards and markers are the principal learning media used in the classroom, whereas student worksheet or LKS tend to be a preferred means of teaching among teachers as instructional material. These handwritten materials are essentially used in assessment process, this even has a greater significance because; many teachers prefer oral test to any other method of assessing their students. The Names associated with teachers' evaluation is more focuse around cognitive assessment, the higher proportion of that stem in to again LOTS (Low Order Thinking Skills), and especially understanding The lowest by far) followed all kinds memorization. Finally, although both refer to affective assessment that most teachers in the US enhance by focusing on discipline and responsibility.

This research contributes to the field of education by identifying the current dominant trends and practices, providing a foundation for developing more effective teaching and assessment strategies. The results of this study can be used as a reference for educators and policymakers in designing teacher training programs and educational policies that are more responsive to post-pandemic needs. Moreover, this research opens opportunities for further studies that can explore innovative ways to enhance the quality of science education at the elementary level.

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