

Exploratory data analysis to reveal learning loss condition in Islamic religious education

Rohmat Mulyana¹, Dian Sa'adillah Maylawati²

¹Department of Islamic Religious Education, Faculty of Tarbiyah and Teaching, UIN Sunan Gunung Djati Bandung, Bandung, Indonesia

²Department of Informatics, Faculty of Science and Technology, UIN Sunan Gunung Djati Bandung, Bandung, Indonesia

Article Info

Article history:

Received Dec 21, 2022

Revised Oct 23, 2023

Accepted Nov 2, 2023

Keywords:

Exploratory data analysis
Islamic religious education
Learning loss
Madrasa
Pandemic

ABSTRACT

One of the negative impacts of this prolonged distance teaching and learning activity during the pandemic is that students lag in absorbing lessons, known as learning loss. Islamic religious education (IRE) as value education, especially in Indonesia, can also cause learning loss. This study aims to identify possible indications of learning loss experienced by madrasa students in IRE. This study uses data science methods with an exploratory data analysis (EDA) approach. Respondents are students in the sixth grade of *Madrasah Ibtidaiyah* (MI), the ninth grade of *Madrasah Tsanawiyah* (MTs), and the twelfth grade of *Madrasah Aliyah* (MA). The total respondents in this study were 38,326 MI students, 29,350 MTs students, and 13,474 MA students. The results of the EDA found that most madrasas in Indonesia experienced indications of learning loss in IRE subjects during distance learning during the COVID-19 pandemic, both at the MI, MTS, and MA levels. This study found that the learning loss condition is influenced by various states and readiness for distance learning, both the preparedness of students to learn independently, the availability of digital content that is interesting and easy to understand, as well as the availability of facilities and technology for distance learning.

This is an open access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



Corresponding Author:

Rohmat Mulyana

Department of Islamic Religious Education, Faculty of Tarbiyah and Teaching,

UIN Sunan Gunung Djati Bandung

Cibiru, Bandung 40614, Indonesia

Email: rohmat.mulyana@uinsgd.ac.id

1. INTRODUCTION

The world of education in Indonesia faces various challenges and dynamics during the COVID-19 pandemic. The use of technology is snowballing in Indonesia due to policies requiring home-schooling during the pandemic. Technology helps educators and students increase innovation and creativity in teaching and learning activities with various media, tools, software, and content that can be widely accessed. However, on the other hand, the quality of education is questionable. Education is not only a transfer of knowledge but also value and skills. Based on the mandate of the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System [1], "National education aims to develop the potential of students to become human beings who believe and fear God Almighty, have a noble character, is healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens."

Technology can be a medium for transferring knowledge. Still, it is not enough to play a role in transferring values and skills that need direct communication, face-to-face, and practice approach. The gap condition in facilities and the use of technology is a big challenge for the world of education during the COVID-19 pandemic. It is one of the triggers for the emergence of learning loss conditions during the

COVID-19 pandemic. Learning loss is a condition where there is a loss of knowledge and skills, both in general and precisely because of the educational process that is experiencing setbacks [2], [3]. Learning loss is caused by prolonged holiday periods, student dropouts, and face-to-face school closures due to critical or urgent conditions such as pandemics. Learning loss in various fields of education due to the COVID-19 pandemic has become a global problem [4]–[7].

The Center for Educational Standards and Policy, Ministry of Education, Culture, Research, and Technology, released a research result from 18,368 elementary school students in grades 1 to 3 in Indonesia. There are indications of a learning loss of 40% for literacy and 56% for numeracy during the COVID-19 pandemic [8]. Of course, this condition needs to be taken seriously. Learning difficulties such as literacy and numeracy at the elementary school level due to learning loss permanently impact the nation's next generation, especially at young levels [9], [10].

The Ministry of Religion, through the Directorate General of Islamic Education, sees the importance of overcoming the learning loss that has occurred in the world of education, especially in madrasa, as a result of the COVID-19 pandemic. Within the framework of Islamic Education, to achieve well-being in 2030, which was compiled by the Organization for Economic Co-operation and Development (OECD) [11], it is necessary to add religious literacy skills to students as illustrated in Figure 1 [12]. Religious literacy can be obtained early through Islamic religious education (IRE). Islamic religious education is a step and pattern of guidance that provides knowledge and shapes students' personality, attitudes, and skills in practicing Islamic teachings and values in daily life [13]. Of course, IRE is in line with the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System and the function of education in transferring value. Therefore, the impact of learning loss during the COVID-19 pandemic on IRE needs to be identified and appropriate mitigation carried out.

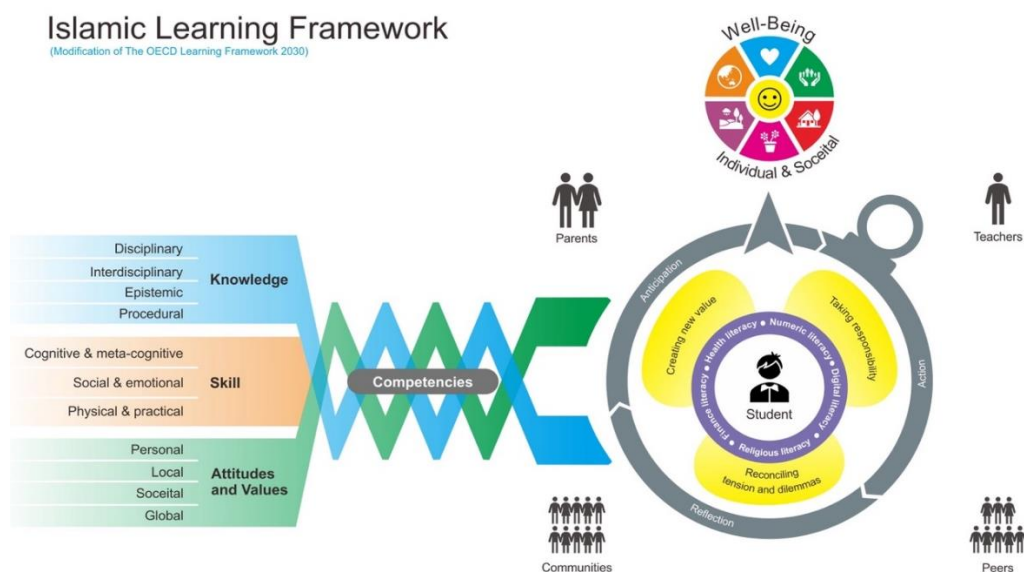


Figure 1. Islamic learning framework (Modification of the OECD learning framework 2030) [12]

In Indonesia, school closures due to the COVID-19 pandemic have also impacted social and economic life, because students who come from families with educated parents and a low economy experience more significant learning loss [14]. This study provides recommendations for overcoming learning loss by adding tutoring during school hours. School closures during the COVID-19 pandemic in Indonesia pose a high risk because even before the pandemic, the quality of education in Indonesia based on the Program for International Student Assessment (PISA) was categorized as low and stagnant [15]. The gap in adequate facilities for teachers and students to support learning activities is relatively high in Indonesia, especially in the outermost, underdeveloped, and frontier regions, including internet infrastructure facilities which are the primary requirement in distance learning [16].

A simulation of the potential impact of school closures during the COVID-19 pandemic in Indonesia, one of which is the level of learning loss, has also been carried out [17]. This study conducted several simulation scenarios and recommended that various parties, especially the government, prepare for better face-to-face teaching and improve the quality of distance education to regain lost learning and improve

the system's quality. Learning loss in online learning taken during the COVID-19 pandemic occurred due to the interaction between the teaching staff and students that was not optimal. The duration of study time and student concentration was lacking, the teaching staff did not complete the learning material, and student's absorption of the material was low [18].

Learning loss is a critical condition that needs to be taken seriously by all parties. Disruption of the learning process by not conducting face-to-face meetings, which results in learning loss, can also have an impact on other problems [6], [19], such as: i) increasing educational gap; ii) decrease in the level of desire to learn; up to iii) the possibility of dropping out (dropping out of school). Various studies have found that learning loss has occurred in literacy (reading), numeracy (counting), science, and learning to write. However, what about IRE, which is essential in transferring values and attitudes and religious literacy to achieve well-being? Therefore, this study identifies the occurrence of IRE learning loss in madrasa as a warning system to deal with madrasa students who have learning loss conditions.

2. RELATED WORKS

Learning loss has become a global issue in the world of education because of the COVID-19 pandemic. The phenomenon or condition of learning loss has emerged since the 1900s when there is a long summer holiday, which is 6-12 weeks [20], [21]. Therefore, the term summer learning loss emerged, and various studies to overcome it [22]–[25]. Allegedly similar to the impact of a long summer holiday, the COVID-19 pandemic has also led to learning loss conditions. Various studies show the occurrence of learning loss, both globally and in Indonesia, because of the COVID-19 pandemic.

Teachers agree that during the COVID-19 pandemic, the cost and effort spent to control online learning at home is relatively high, especially for students who are vulnerable in terms of the economy and the educational facilities they have [26]. Students and teachers in schools with high poverty rates also find virtual classrooms highly ineffective, reinforcing concerns that the pandemic has exacerbated educational inequalities or disparities. England, Canada, and America have higher learning loss rates than Australia, Germany, and France. Meanwhile, Japan and China have lower learning loss conditions than all. In science education, such as Chemistry, disrupted teaching during the COVID-19 pandemic has contributed to learning loss conditions [5]. Even the learning loss experienced is quite significant. The gap between knowledge and skills also appears in this condition, thus hampering student learning progress.

Moreover, more than 1.6 million students in more than 190 countries study outside the classroom during the COVID-19 pandemic, according to UNESCO, and require students to use technology, even simple technologies such as SMS messaging and direct telephone to learn [27]. Even with basic technology, this study discovers long-term implications for using parents and technology as a replacement or addition to the conventional educational system. In Norway, first-graders who were in the class during the pandemic scored lower than their peers who were in the class one year earlier when the COVID-19 epidemic initially occurred in terms of writing quality, handwriting fluency, and attitudes toward writing [28]. This fact also shows that the impact of the COVID-19 pandemic has led to learning loss for students in learning to write.

Concerningly, the negative effects of Pakistan's school closures during the COVID-19 pandemic on students' learning [29]. Based on the Learning Adjusted Years of Schooling, learning time decreased more for female students than for male students. According to the report, a 50% decrease in household spending resulted in the dropout of 7.2 million students, with elementary school dropout rates being higher. According to this study, the government should develop distance learning programs and strong social protection policies to lessen the detrimental effects of school closings on children's academic performance.

The increasing dropout rate is the dire impact of the COVID-19 pandemic apart from learning loss [4]. It is clear from this that the COVID-19 pandemic is causing learning inequality since learning loss is more prevalent among students with low socioeconomic status in high-, middle-, and low-income countries. Dropout rates varied widely from more than 35%. Girls in Kenya and Nigeria are more likely to leave school. Learning loss in Mexico's literacy (reading) and numeracy (mathematics) was also proven. Depending on socioeconomic background, learning loss occurs in the standard deviation range of 0.34-0.45 in reading and 0.62-0.82 in mathematics due to the COVID-19 epidemic [30]. In reading, the increase in learning poverty was between 25.7% and 15.4%, and in arithmetic, it was between 29.8% and 28.8%. The gap in fundamental knowledge by gender and socioeconomic status is also widening.

In Indonesia, school closures due to the COVID-19 pandemic also disrupt social and economic life. Learning loss is more serious for students from low-income families with educated parents [14]. This study provides recommendations for overcoming learning loss by adding tutoring during school hours. Indonesia faces a high risk of school closures during the COVID-19 pandemic because the country's education system was already considered to be of low and stagnant quality based on the PISA [15]. The gap in adequate facilities for teachers and students to support learning activities is relatively high in Indonesia, especially in the outermost, disadvantaged, leading areas, including internet infrastructure facilities which are a significant

need in distance learning [16]. This study found a matrix to identify the relative risk of learning loss. The proposed matrix is based on the learning method and interaction between teachers and students.

Article 31 of Law on Higher Education Number 12 of 2012 seems to be at odds with the possibility of learning loss when it comes to distance learning using digital technology. The use of online learning during the COVID-19 pandemic puts pupils at risk of losing knowledge [31]. Prolonged learning loss risks the development of students' knowledge, skills, values, and character. This study provides strategies to reduce learning losses that occur due to the impact of the COVID-19 pandemic. A simulation of the potential impact of school closures during the COVID-19 pandemic in Indonesia, one of which is the level of learning loss, has also been carried out [17]. This study conducts several simulation scenarios and recommends that various parties, particularly the government, prepare for better face-to-face teaching and the quality of distance education to regain lost learning and improve the system's quality. Learning loss in online learning during the COVID-19 pandemic occurred due to insufficient interaction between teachers and students, insufficient duration of study time and student concentration, teaching staff not finishing delivering learning materials, and student's understanding of the material is low [18].

Based on several studies, it can be concluded that learning loss is a critical condition that needs to be taken seriously by all parties. Disruption of the learning process by not doing face-to-face, which results in learning loss, can also have an impact on other problems [6], [19], such as: i) increasing educational disparities; ii) a decrease in the level of desire to learn; up to iii) the possibility of dropping out (dropping out of school). Various studies have found that there has been a learning loss in literacy (reading), numeracy (counting), science, and learning to write. However, what about IRE, essential in transferring values, attitudes, and religious literacy to achieve well-being? Therefore, this study contributes to identifying and detecting the occurrence of IRE learning loss in madrasa as a warning system to cope with madrasa students who have learning loss conditions. In addition, this study provides recommendations for mitigating learning loss tailored to achieving essential IRE competencies.

3. RESEARCH METHOD

Based on the Decree of the Minister of Manpower of the Republic of Indonesia Number 299 of 2020 concerning the Stipulation of Indonesian National Work Competency Standards for Information and Communication Categories of Main Groups of Programming Activities, Computer Consulting, and Related Activities, Artificial Intelligence Sub-Sector Data Science, this research uses data science methodologies, such as the Indonesian National Work Competency Standards [32]. The main activities include business understanding, data understanding, data preparation, modeling, model evaluation, deployment, and evaluation. Indonesia has 9,681,284 madrasa students from all levels and classes (*Raudhatul Athfal, Madrasah Ibtidaiyah, Madrasah Tsanawiyah, and Madrasah Aliyah*) spread over 83,551 institutions in the odd semester 2020/2021 [33]. This big data can be processed through a data science approach with machine learning technology, and detection of IRE learning loss conditions in madrasa students can be done to give mitigation recommendations according to student needs.

Data science is a modern technique that collaborates statistics by utilizing machine learning technology and artificial intelligence to find interesting patterns, insight knowledge, or meaningful information from big data to help make business decisions [34]–[36]. Because this study has a small to medium-sized population and the population numbers are known, it is enough to take sample data using a standard or sample size formula [37]–[39]. Because this study has a small to medium-sized population and the population numbers are known, it is enough to take sample data using (1).

$$Sample\ size = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N}\right)} \quad (1)$$

With a confidence level of 80%, which means the z-score is 1.28, the margin of error is 0.5, and the standard deviation value is 0.1, the sample of students that must be collected at each level of education is in accordance with the specified sample size. The process of gathering sample data is carried out by considering the balance of the number of students based on gender and province to see the demographic distribution of respondents. Due to the enormous data requirements, the data collection strategy was carried out massively by distributing questionnaires to all madrasas in Indonesia by online. Data collection involved a supervising teacher in supervising students filling out the questionnaire to maintain the data validation. Table 1 provides the needs of research data.

Table 1. The need for research data

Madrasa education level	Data source of highest-grade student		Real data of highest-grade student	
	Population	Sample	Before cleaning	After cleaning
Madrasah Ibtidaiyah (MI)	632,782	259,390	67,998	38,326
Madrasah Tsanawiyah (MTs)	1,081,537	443,200	51,805	29,350
Madrasah Aliyah (MA)	503,969	206,628	23,106	13,474
Madrasah Aliyah Kejuruan (MAK)	99	42		
Total	2,218,387	909,261	534,304	81,150

This study proposes a questionnaire design that adapts several previous learning loss studies and is based on the Decree of the Minister of Religion No. 183 of 2019 concerning the Curriculum of Islamic Religious Education and Arabic in madrasas. Three instruments are adapted for the MI, MTs, MA, and MAK levels. Each instrument is divided into seven groups of questions, including i) Student condition; ii) Family conditions/student learning environment; iii) Learning facilities from schools; iv) Evaluation of the achievement of Al-Quran Hadith subjects; v) Evaluation of *Aqidah Akhlaq* subject achievement; vi) Evaluation of the achievement of Fiqh subjects; and vii) Evaluation of the achievement of Islamic cultural history subjects. So that the total questions for MI respondents were 27 questions, MTs 27 questions, and MA/MAK 31 questions. However, there is one additional question regarding the status of madrasas, whether madrasas are public or private. So that the total questions for MI respondents were 28 questions, MTs 28 questions, and MA/MAK 32 questions. Then added loose questions in the form of impressions, messages, and students' experiences during distance learning during a pandemic.

4. RESULTS AND DISCUSSION

4.1. Data gathering and preparing result

Data were collected from 26 October to 12 November 2022 with the LimeSurvey application. The data collection process took place simultaneously by the students under the supervision of the supervising teacher, who filled out the Minutes and Integrity Pact. Figure 2 shows documentation of the process of filling out the questionnaire reported by the supervisory teacher. Filling in the questionnaire in the field was carried out with various conditions of students and madrasas. Some took turns filling in the questionnaire due to the limitations of the computer laboratory. Some also use smartphones. For madrasas that do not allow their students to carry smartphones, the process of filling out the questionnaire simultaneously online through video conferencing media such as Zoom or Google Meet is supervised by the supervisory teacher. The role of the supervising teacher is crucial to maintain and ensure that students directly fill out the questionnaire.



Figure 2. Questionnaire data collection documentation

Data that has been entered through the LimeSurvey application is then extracted in the Comma Separated Value (CSV) file format. The preliminary data collected amounted to 67,998 for MI level respondents, 51,805 for MTs level respondents, and 23,106 for MA/MAK level. Questionnaire questions are coded according to data processing needs in facilitating data processing. After coding, data analysis was carried out using descriptive statistics to identify the initial data. There are missing data from the initial data,

so the missing value data is cleaned. After the data was cleaned, there were 38,326 data for MI level respondents, 29,350 data for respondents with MTs level, and 13,474 data for MA level respondents. Even though the data did not reach the target sample, the data reached 5-10% of the target sample data, and the data that was processed was clean data without missing values and redundant data.

4.2. Exploratory data analysis result

Exploratory data analysis (EDA) was introduced as a procedure for analyzing data. EDA is a technique to interpret data more easily, accurately, and precisely. The EDA result is mathematics (statistics) which is processed by machines automatically and can be applied to analyze data [40], [41]. Numbers such as mean, median, maximum value, minimum value, and quartiles are summarized by EDA. EDA seeks to offer theories regarding the origins of observed events, evaluate the premises upon which statistical results are founded, assist in the choice of suitable statistical methodologies, and serve as a foundation for additional data collecting.

Graphical approaches like box plots, histograms, scatter plots, multidimensional scaling, principal component analysis, and interactive plots are typically used to show EDA results. EDA is typically used at the pre-crossing stage of data mining or machine learning approaches to visualize, identify gaps in data, and look for connections between data or variables. The pre-processing stage is crucial for data integration, selection, and cleaning to increase quality, transformation, and reduction to conduct an effective mining process. In this study, EDA was carried out for each data based on educational level: MI level data, MTs level data, and MA level data. Figure 3 shows the respondent distribution based on provinces.

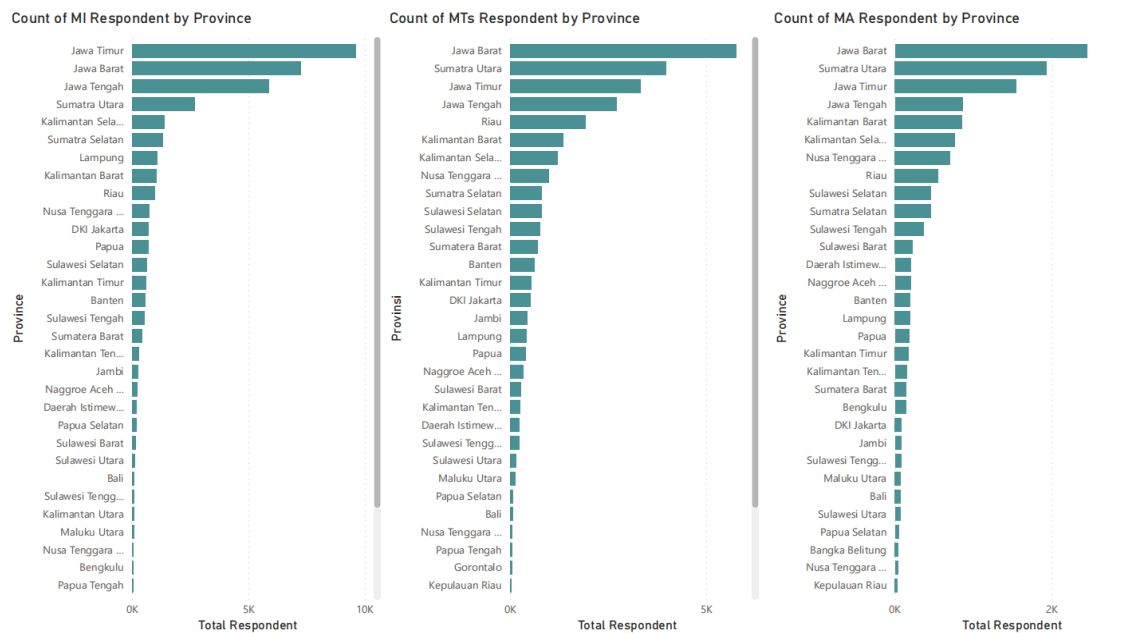


Figure 3. Distribution of respondents based on province

4.2.1. Madrasah Ibtidaiyah (MI)

The total number of respondents for *Madrasah Ibtidaiyah* (MI) students was 38,326, with a total number of female respondents 19,554, while the total number of male respondents was 18,772 in all provinces. Most respondents came from East Java, with a percentage of 12.81% of the total number of respondents. The number of respondents from private madrasas is higher than public madrasas, namely 91.85% compared to 8.15%. This data shows that it is reasonable because, based on Ministry of Religion Data Source (EMIS), there are more private MI than public MI.

Regarding learning media, based on a survey, 84% of respondents received textbooks from schools, while 16% said they did not receive these facilities. Apart from textbooks, during the COVID-19 pandemic, 71.7% of respondents said learning materials and content were also available in digital form. This shows that most students have access to material, both in print and online. Respondents without printed books, due to various conditions experienced, can still access learning materials online. The availability of learning materials in print and digital form should complement each other's learning needs during distance learning.

The internet availability at home to support distance learning only reached 62.5%, while the other 37.5% did not have internet facilities. In addition to internet availability at home, most madrasa students get internet support from the school, reaching 72.7%. Supporting facilities are also supported by the availability of smartphones reaching 82.3%. However, most students do not have laptops or computers, a percentage of 68.78%. Based on the availability of distance learning device facilities, most students have sufficient devices. Even though most do not have laptops or computers, students have the smarts to access material and follow learning. Internet quota support for students from schools has also become a form of school concern to expedite teaching and learning activities during the pandemic.

Based on the results of the EDA on the MI-level student, it is indicated that most of the MI students experience learning loss for IRE subjects as shown in Figure 4. Based on the provincial distribution, with a score of 72.19, North Kalimantan has an average IRE score with the highest Total Score compared to other provinces. This value is 88.09% higher than Bangka Belitung, which has an average IRE value with the lowest Total Value of 38.83%. North Kalimantan, DKI Jakarta, and Bali have learning facilities, devices, and quota support from good schools. Most students have laptops, cell phones, and internet facilities at home.

Meanwhile, Bangka Belitung has the lowest average grade and has less supportive learning facilities. Most do not have laptops or computers, although access to materials and learning can be accessed via smartphones. Then, even though most students get quota assistance from the school, most students also do not have internet facilities at home. So, it is possible that if the quota assistance from the school has run out, distance learning will not be carried out optimally.

The average IRE total score and minimum completeness criteria (MCC) correlate negatively. Of all 37 provinces, the average IRE score ranges from 38.33 to 72.19. The Min Total IRE Score ranges from 0 to 31, and the Max IRE Score ranges from 75 to 100. Suppose the MMC for IRE subjects is 65-75. In that case, this fact shows that in addition to North Kalimantan, DKI Jakarta, and Bali, other provinces indicated a learning loss in IRE subjects during the COVID-19 pandemic at the MI level. This fact is also consistent with the survey's findings regarding the perceptions and experiences of students who took distant learning courses during the COVID-19 pandemic. Most students believe remote learning is less effective and have trouble comprehending the course material.

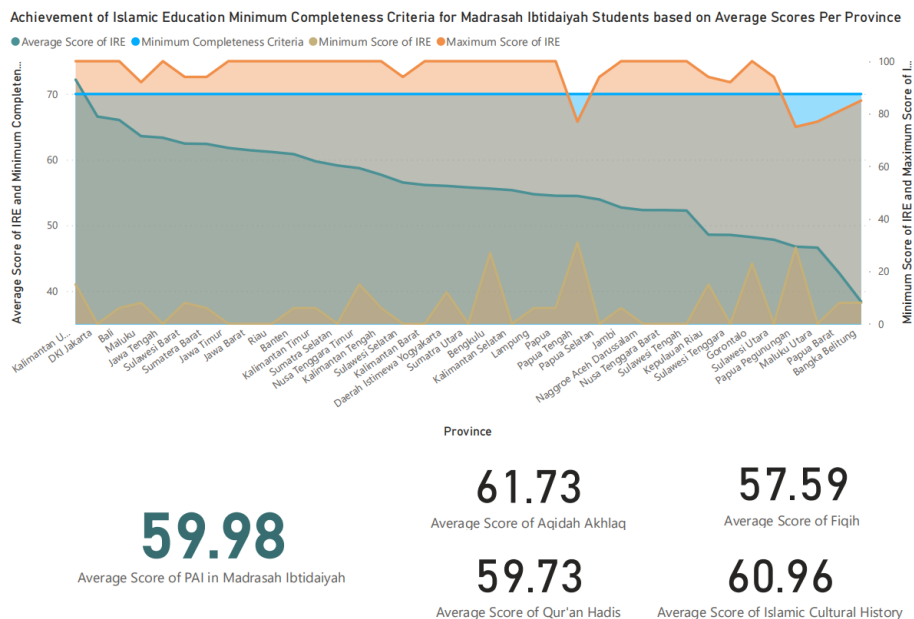


Figure 4. Achievement of IRE for MI

4.2.2. Madrasah Tsanawiyah (MTs)

Of the total 29,350 students at the *Madrasah Tsanawiyah* (MTs) level, the number of female respondents was higher, namely 16,100 people, while the number of male respondents was 13,250 in all provinces. Most respondents came from West Java, with a percentage of 10.89% of the total number of respondents. The number of respondents from private schools is higher than public schools, namely 87.9% compared to 12.1%. This data shows that it is reasonable because, based on EMIS data, there are more private MTs than public MTs.

Regarding learning media, based on a survey, 80% of respondents received textbooks from schools, while 20% said they did not receive these facilities. Apart from textbooks, during the COVID-19 pandemic, 71.7% of respondents said learning materials and content were also available online. This result shows that most students have access to material, both in print and online. Respondents without printed books, due to various conditions experienced, can still access learning materials online. The availability of learning materials in print and digital form should complement each other's learning needs during distance learning at home.

The internet availability at home to support distance learning only reached 65.3%, while the other 34.7% did not have internet facilities. Apart from internet availability at home, most madrasa students get internet support from the school, which reaches 60.22%. Supporting facilities are also supported by the availability of smartphones reaching 83.83%. However, most students do not have laptops or computers, with a percentage of 68.02%. Based on the availability of distance learning device facilities, most students have sufficient devices. Even though most don't have laptops or computers, students have the smarts to access material and follow learning. Internet quota support for students from schools has also become a form of school concern to expedite teaching and learning activities during the pandemic.

Based on the results of the EDA conducted on questionnaire data for students at the MTs level, it is indicated that most MTs students experience learning loss for IRE subjects as presented in Figure 5. With a score of 71.67, Papua Mountains has an average IRE score with the highest total score. This value is higher than West Papua, which has an average IRE score with the lowest total score of 27.06. There is only one respondent from Papua in the Mountains, so it is too early for further analysis. The next province that has the highest average score is Bali, with a score of 61.76. The learning facilities for MTs students in Bali are pretty good. Most students use smartphone devices to access materials and participate in learning. Almost all respondents do not have a laptop or computer device. Even though not all students have internet access at home, quota assistance from schools is received by most MTs students. Contrary to West Papua, which has the lowest average score, most respondents do not receive internet quota assistance from schools. Then, the availability of digital content or material that can be accessed online was not found by most of the respondents.

The average IRE total score and MCC correlate negatively. Of all 37 provinces, the average value of IRE ranges from 27.06 to 71.67. Then, the max total value of IRE ranges from 67.5 to 100. As for each subject, the average value of *Fiqh* is in the lowest position, with a score of 34.77. Suppose the MCC for IRE subjects is 65-75. In that case, this fact shows that apart from Papua Mountains, there are indications of learning loss in IRE subjects during the COVID-19 pandemic at the MTs level in other provinces. This fact is also in line with the results of the freelance questionnaire in the form of students' opinions and experiences while carrying out distance learning during the COVID-19 pandemic. Most students think that distance learning is less effective, and students find it challenging to understand learning material.

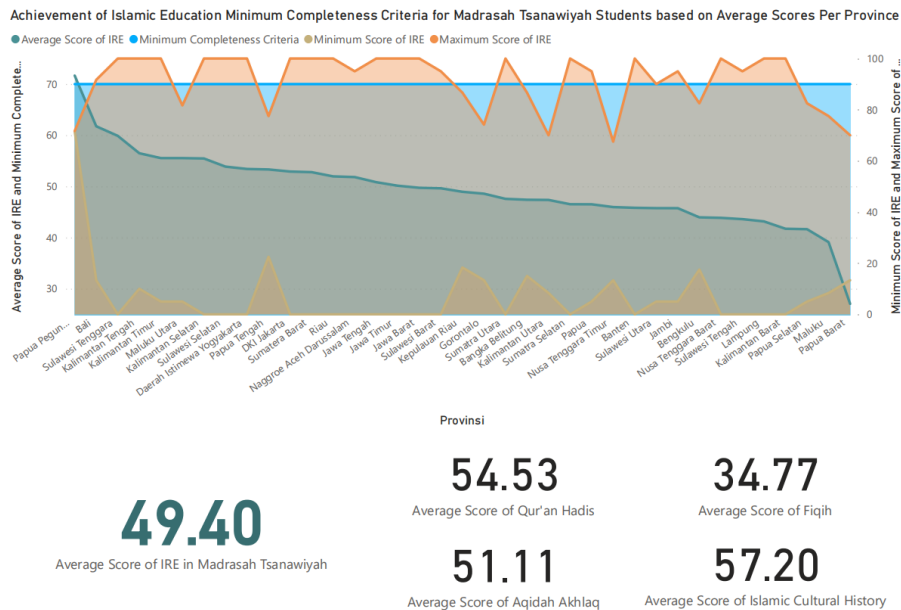


Figure 5. Achievement of IRE for MTs

4.2.3. Madrasah Aliyah (MA)

Madrasah Aliyah (MA) respondents are grade 12 students in 2022, totaling 13,474. The total number of female respondents was 8,150, while the total number of male respondents was 5,324 in all provinces. Most respondents came from West Java, with a percentage of 11.30% of the total number of respondents. The number of respondents from private schools is higher than public schools, namely 90.9% compared to 9.1%. This data shows that it is reasonable because, based on EMIS data from the Ministry of Religion, there are more private MA than public MA.

Regarding learning media, based on the survey, 72.1% of respondents received package books/textbooks from schools, while 27.9% said they did not receive these facilities. Apart from textbooks, during the COVID-19 pandemic, 73.3% of respondents said learning materials and content were also available online. This research shows that most students have access to material, both in print and online. Respondents without printed books, due to various conditions experienced, can still access learning materials online. The availability of learning materials in print and digital form should complement each other’s learning needs during distance learning at home.

The internet availability at home to support distance learning only reached 58.8%, while the other 41.2% did not have internet facilities. Learning support device facilities are also supported by the availability of smartphones reaching 86.22%. However, most students do not have laptops or computers, with a percentage of 67.16%. Based on the availability of distance learning device facilities, most students have sufficient devices. Even though most do not have laptops or computers, students have the smarts to access material and follow learning.

Based on the results of the EDA on questionnaire data for MA-level students, it was indicated that most of the MA students experienced learning loss for IRE subjects as presented in Figure 6. With a score of 55.14, Papua has an average IRE score with the highest total score. This value is 94.62% higher than Papua Pegunungan, which has an average IRE score with the lowest Total Score of 28.33. The condition of learning support facilities in Papua is quite suitable for MA-level students. Most MA students have internet facilities at home, laptops or computers, and smartphones as devices used for distance learning activities during the COVID-19 pandemic. The availability of content or material in digital form that can be accessed online is also obtained by most MA students in Papua. Papua conditions differ from Papua Pegunungan, which has the lowest average score. However, respondents from Papua Mountains were insufficient for in-depth analysis because they only consisted of two respondents who did not have laptops or computer facilities and learning materials were not available in digital form. West Papua Province is the province that has the lowest average score after Mountain Papua. In West Papua, most students do not have internet facilities at home or laptops or computers. Most of them also don’t have textbooks, and even though there is content provided digitally, many students feel they don’t get material or content in digital form.

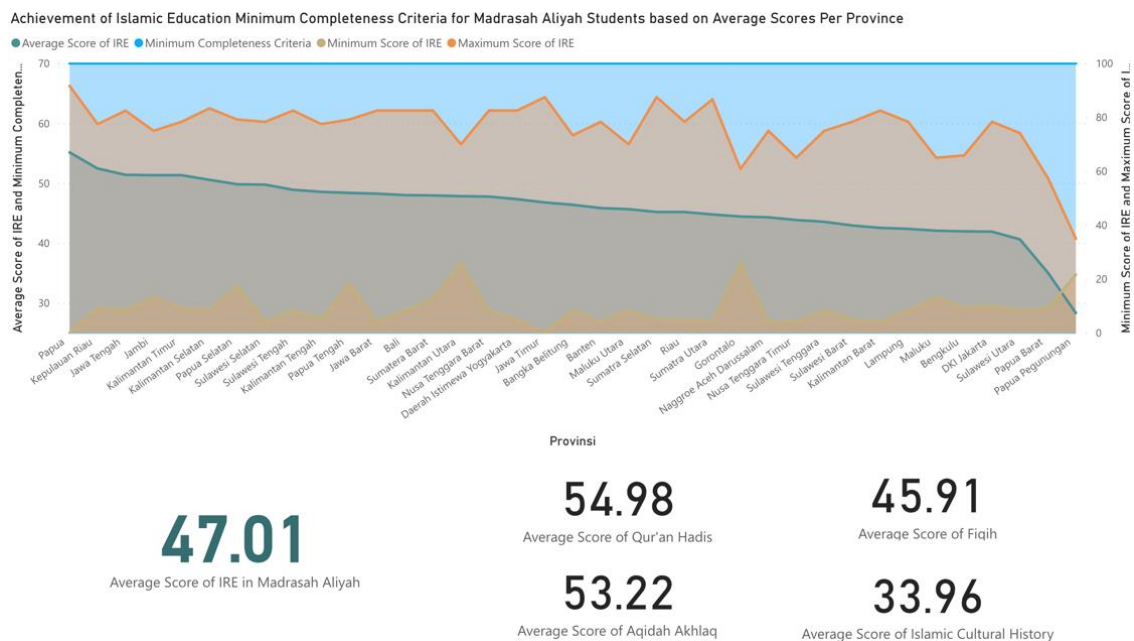


Figure 6. Achievement of IRE for MA

The average IRE total score and MCC total correlate negatively. Of all 37 provinces, the average total score of IRE ranged from 28.33 to 55.14, and the max total score of IRE ranged from 35 to 91.67. As for each subject, the average value of Islamic cultural history is in the lowest position, scoring 33.96. Suppose the MCC for IRE subjects is 65-75. This fact shows that apart from Papua Pegunungan, there are indications of learning loss in IRE subjects during the COVID-19 pandemic at the MA level in other provinces. This fact is in line with the results of the freelance questionnaire in the form of students' opinions and experiences while carrying out distance learning during the COVID-19 pandemic. Most students think that distance learning is less effective and students find it challenging to understand learning material.

4.3. Correlation diagram result

The correlation diagram visualizes the relationship between variables. The range of values on the correlation diagram is -1 to 1. So, the correlation diagram illustrates the positive or negative relationship between variables. Figures 7(a) to 7(c) show the correlation between variables in the MI, MTs, and MA-level respondent data, respectively. Overall, the correlation between the total IRE value variables and the other four value components, namely the values of the Al-Quran, Hadith, *Aqidah Akhlaq*, Fiqh, and Islamic cultural history, is relatively high. Both on MI, MTs, and MA data. It explains the close relationship between each assessment component and IRE's total value.

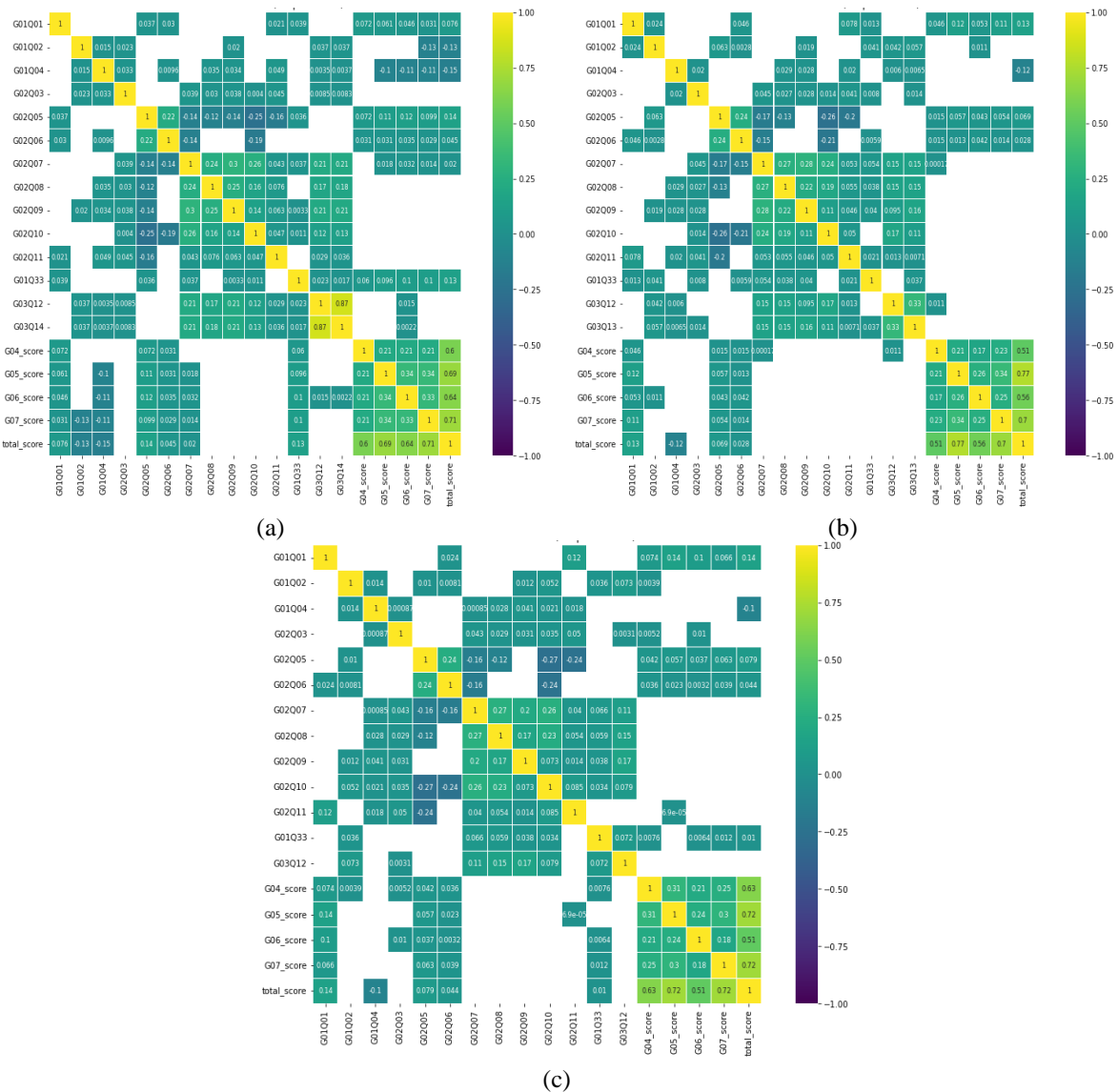


Figure 7. Result of correlation diagram in (a) MI, (b) MTs, and (c) MA respondent

An interesting correlation is found in MI-level data. The variables “Availability of content/material online” and “Internet quota assistance support from schools” are positively related, with a high correlation value of 0.87. This close linkage can be obtained from quota assistance schools provide to support access to learning materials or content. Or vice versa, because material or content is available online, schools must support student access to material by providing internet quota assistance. However, in MTs level data, these two variables only have a correlation value of 0.33, which means that the availability of quota assistance from schools does not always support the availability of online materials.

The mother’s final education variable and the estimated monthly expenditure are also positively correlated with a value of 0.22 for MI data and 0.24 for MTs and MA data. An exciting and consistent correlation from all data (MI, MTs, and MA data) is the textbooks, internet availability at home, smartphone availability, and laptop or computer availability. The resulting correlation value is positive, ranging between 0.22 to 0.3. This correlation is quite interesting because internet facilities at home must also support the availability of smartphones and laptops or computers. These variables are interrelated as supporting facilities for distance learning carried out at home during the COVID-19 pandemic.

4.4. Word cloud analysis result

Word cloud is a data visualization generally in the form of text. Word cloud presents an overview of the frequency of words that can be displayed in an attractive but informative form. The more often a word is used, the larger the size of the word is shown in the word cloud. In this study, word cloud analysis was conducted through students’ answers regarding loose-leash questions in the form of impressions, messages, and students’ experiences during distance learning during the pandemic. Figure 8 shows the MI, MTs, and MA word cloud data.

In the MI data, the words or phrases that appear most often include ‘*belajar* (studying)’, ‘*rumah* (home)’, ‘*teman* (friends)’, ‘*bertemu* (meeting)’, ‘*tidak bertemu* (not meeting)’, ‘*tatap muka* (face to face)’, ‘*baik* (good)’, and ‘*kurang menyenangkan* (unpleasant)’. Other negative words are also found in this word cloud, such as: ‘*sulit memahami* (difficult to understand)’, ‘*kurang paham* (difficult to understand)’, ‘*susah* (difficult)’, ‘*kurang efektif* (less effective)’, ‘*sangat membosankan* (very boring)’, ‘*kurang seru* (less exciting)’, ‘*kurang memuaskan* (unsatisfying)’, and ‘*kurang maksimal* (not maximal)’. This result illustrates the impression felt by MI students regarding learning at home during the pandemic. Most MI respondents felt that learning was less fun and effective and had difficulty understanding learning material.



Figure 8. Word cloud analysis

Words or phrases that often appear in the word cloud for MTs level data are ‘*belajar* (learning)’, ‘*rumah* (home)’, ‘*bertemu teman* (meeting friends)’, ‘*teman* (friends)’, ‘*kurang menyenangkan* (less fun)’, ‘*memahami materi* (understanding the material)’, ‘*tatap muka* (face to face)’, ‘*selama pandemi* (during a pandemic)’, ‘*kurang efektif* (less effective)’, and ‘*baik* (good)’. In line with MI respondents, MTs respondents also felt that studying at home during the pandemic was less effective and had difficulty understanding the material. It is also less fun because the respondents cannot meet their friends.

Whereas in the MA level data the words or phrases that often appear in the word cloud are ‘*belajar* (learning)’, ‘*rumah* (home)’, ‘*tatap muka* (face to face)’, ‘*kurang efektif* (less effective)’, ‘*selama pandemi* (during a pandemic)’, ‘*memahami materi* (understand the material)’, ‘*sangat membosankan* (very boring)’,

and '*teman* (friends)'. The opinions of MA level students while carrying out distance learning at home during the COVID-19 pandemic were not much different from those of MI and MTs students. Most respondents said that distance learning during the pandemic was boring, less effective, and they did not understand the material well. Besides, studying at home is boring because you can't meet your friends.

4.5. Discussion

The COVID-19 pandemic period demanded adaptation to the teaching and learning process in the world of education, especially in the madrasa environment. Concerns about the occurrence of learning loss conditions experienced by students should be considered seriously [6], [7], [19], [26]. This study found that during the COVID-19 pandemic there was a decline in students in madrasas (both MI, MTs, and MA) in understanding Islamic education subject matter. This condition is indicated as learning loss. Various factors influence the occurrence of learning loss conditions which are not sufficiently measured only by the values obtained from IRE subjects. Based on the findings, this study recommends several things, including strengthening or repeating IRE materials for students indicated to have experienced learning loss or have not fulfilled the MCC.

Then, restore the teacher's role as an ethical guide because the role of the teacher cannot be replaced by technology [42] and cannot replace face-to-face education [43]. IRE learning material is easier for students to understand if there is a teacher's role as a facilitator and ethical guide who guides them while studying IRE material. Synchronous educational interactions cannot be replaced, even by using video conferencing technology, which is less effective for students understanding IRE material. There are also findings that while studying at home, it turns out that the role of parents, especially mothers, is very influential. The learning loss occurs more in students whose mothers have elementary school education or the equivalent. Most likely due to the reduced role of the teacher as an ethical guide and the lack of the mother's education, student learning at home is not optimal.

Providing attractive content or learning materials in digital form that meet content standards for distance learning are important [44]. For example, content standards include the availability of learning guides, learning videos, lecture notes, pop quizzes or quizzes included in videos interactively, discussion forums, quiz reviews, external links, and assignments. Apart from that, preparing video content also has standards, such as the duration of the video that is prepared at least 3 minutes and a maximum of 7 minutes. Each discussion provides a maximum of 7 videos. So there needs to be increased teacher competence in creating standard and creative digital content so that distance learning can run more optimally and be fun. Then, online libraries and digital textbooks should support the learning materials [45], [46].

Support for learning facilities and tools must be adequate [19], [31]. These facilities include the availability of an internet network, laptops or computers, smartphones, and other technological needs. Therefore, student access to various learning facilities and devices in distance learning must be evenly distributed. Schools should have adequate facilities to support student learning. Last, it is necessary to carry out special treatment for students who are indicated to be experiencing learning loss, for example, giving re-item or special classes. However, it is necessary first to identify the factors that cause this learning loss condition and students' experiences.

This research contributes as an initial finding to overcome the condition of learning loss IRE in madrasa students, which can have a sustainable impact. In addition, this research ensures that the transfer of value through IRE is not lost due to the impact of the COVID-19 pandemic and can be mitigated appropriately to create well-being through education. More specifically, this research makes a scientific contribution to the development of IRE by utilizing data science technology. Furthermore, it can overcome and break learning loss in IRE in madrasas. This research can be a warning system for educators and parents of students to overcome the possibility of learning loss conditions in madrasa students. This research can also contribute to policymakers as material for consideration in decision-making and become a recommendation for drafting regulations in tackling learning loss in IRE in madrasas.

5. CONCLUSION

With most of the population embracing Islam, Indonesia has Islamic religious education, instilling values and attitudes in students. Through IRE, education of the Quran, Hadith, *Aqidah*, *Akhlaq*, *Fiqh*, and Islamic cultural history is delivered to provide good values to students. Based on the EDA results, MI, MTs, and MA have an average IRE score that has not yet reached the MCC if the MCC is 65-75. It also aligns with the opinions of MI, MTs, and MA students who say that distance learning at home during a pandemic is less effective and challenging to understand the material. Difficulty understanding the material can also be influenced by the availability of less attractive learning materials and learning conditions that are less enjoyable because they cannot interact with friends directly, which can increase enthusiasm for learning.

However, the EDA results were based on the scores for each component of the IRE subject: Quran Hadith, *Aqidah Akhlaq*, *Fiqh*, and Islamic cultural history. Learning loss conditions are experienced not only based on value factors but also other factors, such as the condition of students and the availability of learning facilities, such as access to learning materials and equipment. Therefore, future research will stop at not only EDA results but also segment data with indications of learning loss and not. Furthermore, a detection model was built as a form of prevention and early mitigation of students who experience learning loss. Segmentation and learning loss detection models can be built using machine learning techniques.

ACKNOWLEDGEMENTS

The authors would like to thank the Directorate General of Islamic Education, Ministry of Religion of the Republic of Indonesia, for supporting the implementation of this research based on the Decree of the Chancellor of UIN Sunan Gunung Djati Bandung No: 4959/Un.05/V.2/TL.03/10/2022 concerning Educational Policy Research Assistance.




REFERENCES

- [1] Government of the Republic of Indonesia. "Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System," Jakarta (in Indonesian), 2003.
- [2] D. R. Rizaldi, Z. Fatimah, S. Susilawati, and M. Makhrus, "Student Responses related to Face-to-Face Learning Policies to Overcome Learning Loss Condition," *Journal of Science and Science Education*, vol. 3, no. 1, pp. 9–16, 2022.
- [3] F. Simal, D. Mahulauw, M. Leasa, and J. R. Batlolona, "Self Awareness and Mitigation of Learning Loss on Students' Science Learning Outcomes During the Covid 19 Pandemic," *Jurnal Penelitian Pendidikan IPA*, vol. 8, no. 1, pp. 239–246, 2022.
- [4] L. Moscoviz and D. K. Evans, "Learning loss and student dropouts during the covid-19 pandemic: A review of the evidence two years after schools shut down," *Center for Global Development, Working Paper*, vol. 609, 2022.
- [5] K. L. Turner, M. Hughes, and K. Presland, "Learning loss, a potential challenge for transition to undergraduate study following COVID19 school disruption," *Journal of Chemical Education*, vol. 97, no. 9, pp. 3346–3352, 2020, doi: 10.1021/acs.jchemed.0c00705.
- [6] R. Donnelly and H. A. Patrinos, "Learning loss during COVID-19: An early systematic review," *Prospects*, vol. 51, pp. 601–609, 2021, doi: <https://doi.org/10.1007/s11125-021-09582-6>.
- [7] E. Dorn, B. Hancock, J. Sarakatsannis, and E. Viruleg, "COVID-19 and learning loss—disparities grow and students need help," McKinsey & Company, 2020.
- [8] Pusat Standar dan Kebijakan Pendidikan, *Learning Situations in the Pandemic Period*. Jakarta: Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi (in Indonesian), 2022.
- [9] J. J. Cerelia *et al.*, "Learning Loss Due to Distance Learning During the COVID-19 Pandemic in Indonesia," (in Indonesian), in *Prosiding Seminar Nasional Statistika*, 2021, p. 27.
- [10] D. I. Savitri, "Case Study of Difficulty Learning to Read for Elementary School Students Impact of Learning Loss," (in Indonesian), *JiIP-Jurnal Ilmiah Ilmu Pendidikan*, vol. 5, no. 8, pp. 3084–3089, 2022, doi: <https://doi.org/10.54371/jiip.v5i8.769>.
- [11] Organization for Economic Co-operation and Development (OECD), "The Future of Education and Skills (Education 2023)," 2018. [Online]. Available: [https://www.oecd.org/education/2030/E2030 Position Paper \(05.04.2018\).pdf](https://www.oecd.org/education/2030/E2030%20Position%20Paper%20(05.04.2018).pdf).
- [12] M. A. Ramdhani, "Islamic Learning Framework (Modification of the OECD Learning Framework 2030)," Jakarta, 2021.
- [13] A. R. Nurjaman, *Islamic education*. Bumi Aksara (in Indonesian), 2020.
- [14] C. F. Pasani, R. Amelia, and Z. Hassan, "Learning Loss and Education Inequality in Indonesia (Mapping the Potential, Consequences, and the COVID-19 Crisis)," *Review of International Geographical Education Online*, vol. 11, no. 10, pp. 1171–1181, 2021.
- [15] Organization for Economic Co-operation and Development (OECD), "Program for International Student Assessment (PISA)," [Online]. Available: <https://www.oecd.org/pisa/data> (accessed: Aug. 20, 2022).
- [16] S. Arsendy, C. J. Gunawan, N. Rarasati, and D. Suryadarma, "Teaching and Learning During School Closure: Lessons from Indonesia," *ISEAS Yusof Ishak Institute Perspective*, vol. 89, no. 2020, pp. 1–11, 2020.
- [17] N. Yarrow, E. Masood, and R. Afkar, *Estimates of COVID-19 Impacts on Learning and Earning in Indonesia: How to Turn the Tide*. World Bank, Washington, DC, 2020. [Online]. Available: <http://hdl.handle.net/10986/34378>.
- [18] W. Andriani, M. Subandowo, H. Karyono, and W. Gunawan, "Learning loss in online learning during the corona pandemic," (in Indonesian), in *Seminar Nasional Teknologi Pembelajaran*, 2021, pp. 484–501.
- [19] P. Engzell, A. Frey, and M. D. Verhagen, "Learning loss due to school closures during the COVID-19 pandemic," *Proceedings of the National Academy of Sciences*, vol. 118, no. 17, p. e2022376118, 2021, doi: <https://doi.org/10.1073/pnas.2022376118>.
- [20] T. Kerry and B. Davies, "Summer learning loss: The evidence and a possible solution," *Support for Learning*, vol. 13, no. 3, pp. 118–122, 1998, doi: <https://doi.org/10.1111/1467-9604.00072>.
- [21] H. Cooper, B. Nye, K. Charlton, J. Lindsay, and S. Greathouse, "The effects of summer vacation on achievement test scores: A narrative and meta-analytic review," *Review of Educational Research*, vol. 66, no. 3, 1996, doi: 10.3102/00346543066003227.
- [22] K. Alexander, S. Pitcock, and M. C. Boulay, *The Summer Slide: What We Know and Can Do About Summer Learning Loss*. Teachers College Press, 2016. doi: https://doi.org/10.1162/edfp_a_00213.
- [23] A. McEachin and A. Atteberry, "The impact of summer learning loss on measures of school performance," *Education Finance and Policy*, vol. 12, no. 4, pp. 468–491, 2017.
- [24] M. Kuhfeld, "Surprising new evidence on summer learning loss," *Phi Delta Kappan*, vol. 101, no. 1, pp. 25–29, 2019, doi: <https://doi.org/10.1177/0031721719871560>.
- [25] J. Shinwell and M. A. Defeyter, "Investigation of summer learning loss in the UK-Implications for holiday club provision," *Frontiers in Public Health*, vol. 5, p. 270, 2017, doi: <https://doi.org/10.3389/fpubh.2017.00270>.
- [26] L.-K. Chen, E. Dorn, J. Sarakatsannis, and A. Wiesinger, "Teacher survey: Learning loss is global-and significant," McKinsey & Company, 2021.




- [27] N. Angrist, P. Bergman, C. Brewster, and M. Matsheng, "Stemming learning loss during the pandemic: A rapid randomized trial of a low-tech intervention in Botswana," *SSRN*, 2020, doi: 10.2139/ssrn.3663098.
- [28] G. B. U. Skar, S. Graham, and A. Huebner, "Learning loss during the COVID-19 pandemic and the impact of emergency remote instruction on first grade students' writing: A natural experiment," *Journal of Educational Psychology*, vol. 114, no. 7, pp. 1553–1566, 2021, doi: <https://doi.org/10.1037/edu0000701>.
- [29] M. J. Khan and J. Ahmed, "Child education in the time of pandemic: Learning loss and dropout," *Children and Youth Services Review*, vol. 127, p. 106065, 2021, doi: <https://doi.org/10.1016/j.chilyouth.2021.106065>.
- [30] F. J. Hevia, S. Vergara-Lope, A. Velásquez-Durán, and D. Calderón, "Estimation of the fundamental learning loss and learning poverty related to COVID-19 pandemic in Mexico," *International Journal of Educational Development*, vol. 88, p. 102515, 2022, doi: <https://doi.org/10.1016/j.ijedudev.2021.102515>.
- [31] A. Wahyudi, "Learning Loss during Covid-19 Pandemic in Indonesia and the Strategies to Minimize It," *Journal of English Education and Linguistics*, vol. 2, no. 2, pp. 18–25, 2021, doi: <https://doi.org/10.56874/jeel.v2i2.579>.
- [32] Ministry of Manpower of the Republic of Indonesia. "Decree of the Minister of Manpower of the Republic of Indonesia Number 299 of 2020 Regarding the Determination of Indonesian National Work Competency Standards Category Information and Communication Main Group Activities Programming, Computer Consulting, and Related Activities Field of Expertise Artificial Intelligence Subfield Data Science," (in Indonesian), 2020.
- [33] Direktorat Jenderal Pendidikan Islam Kementerian Agama RI, "Recapitulation of Basic Islamic Education Data (Madrassa Odd Semester 2020/2021)." (in Indonesian). [Online]. Available: <https://emis.kemenag.go.id> (accessed: Aug. 20, 2022).
- [34] V. Dhar, "Data science and prediction," *Communications of the ACM*, vol. 56, no. 12, pp. 64–73, 2013, doi: 10.1145/2500499.
- [35] F. Provost and T. Fawcett, *Data Science for Business: What you need to know about data mining and data-analytic thinking*. O'Reilly Media, Inc., 2013.
- [36] W. Van Der Aalst, *Process mining: data science in action*. Springer, 2016. doi: <https://doi.org/10.1007/978-3-662-49851-4>.
- [37] P. Kadam and S. Bhalerao, "Sample size calculation," *International Journal of Ayurveda Research*, vol. 1, no. 1, pp. 55–57, 2010, doi: <https://doi.org/10.4103%2F0974-7788.59946>.
- [38] G. D. Israel, *Determining sample size*. Florida: University of Florida Cooperative Extension Service, Institute of Food and Agriculture Sciences, 1992.
- [39] A. Fink, *How to sample in surveys*, vol. 7. Sage Publication, 2003.
- [40] J. W. Tukey, "The Future of Data Analysis," *The Annals of Mathematical Statistics*, 1962, doi: 10.1214/aoms/1177704711.
- [41] D. C. Hoaglin, "John W. Tukey and Data Analysis," *Statistical Science*, 2004, doi: 10.1214/ss/1076102418.
- [42] H. Hanafiah, R. S. Sauri, D. Mulyadi, and O. Arifudin, "Overcoming the Impact of Learning Loss in Improving the Quality of Learning in High Schools," (in Indonesian), *JiIP-Jurnal Ilmiah Ilmu Pendidikan*, vol. 5, no. 6, pp. 1816–1823, 2022, doi: <https://doi.org/10.54371/jiip.v5i6.642>.
- [43] D. Güvercin, A. Kesici, and S. AKBAŞLI, "Distance education experiences of teacher-parents during the COVID-19," *Athens Journal of Education*, vol. 9, no. 4, 2022, doi: <http://doi.org/10.30958/aje.9-4-4>.
- [44] A. Muthmainnah and S. Rohmah, "Learning loss: Distance learning analysis," (in Indonesian), *Jurnal Kewarganegaraan*, vol. 6, no. 1, pp. 969–975, 2022.
- [45] J. Zhou, "The role of libraries in distance learning during COVID-19," *Information Development*, vol. 38, no. 2, pp. 227–238, 2022, doi: 10.1177/026666669211001502.
- [46] M. Brnic and G. Greefrath, "Distance learning versus face-to-face classroom learning: student achievement in conditional probability when using a digital textbook with integrated digital tools," in *Twelfth Congress of the European Society for Research in Mathematics Education (CERME12)*, 2022.

BIOGRAPHIES OF AUTHORS



Rohmat Mulyana    completed his Doctoral Program in Values Education from the University of Education Indonesia in 2001. He is a Lecturer in Islamic Education at the Postgraduate Program, Universitas Islam Negeri (UIN) Sunan Gunung Djati Bandung. In addition, he has been the Head of the Sub-Directorate of Institutional and Cooperation of the Directorate of Madrasah Education of the Ministry of Religion, Director of Islamic Education of the Ministry of Religion, and currently, he is the Secretary of the Directorate General of Islamic Education of the Ministry of Religion of the Republic of Indonesia. He can be contacted at email: rohmat.mulyana@uinsgd.ac.id



Dian Sa'adillah Maylawati    got Ph.D from the Centre for Advanced Computing Technology, Faculty of Information and Communication Technology in Universiti Teknikal Malaysia Melaka (UTeM), Malaysia. She got a Master degree from Bandung Technology Institute, Indonesia. She is also lecturer in Department of Informatics at UIN Sunan Gunung Djati Bandung, Indonesia. Her current research interests focus on Software Engineering, Machine Learning, Data Science, and Natural Language Processing. She can be contacted at email: diansm@uinsgd.ac.id