# DESIGN OF LEARNING MANAGEMENT SYSTEM TO SUPPORT MUSICAL PRACTICE EVALUATION: A CASE STUDY ON GAMELAN SALENDRO PRACTICE

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## Abstract

This study designs a learning management system (LMS) to facilitate practical learning of musical instruments, particularly Gamelan Salendro, employing key performance indicators (KPI) for evaluation. The design thinking methodology evaluates students by creating a web prototype. Empathize, define, ideate, prototype, and test comprise the KPI-based music assessment information system. The results reveal that this LMS can accurately track students' vocal practice of all Salendro Gamelan waditra (instruments). This information system allows staged evaluations with educator-student reflection. Using this LMS to simplify learning and provide progress tracking and detailed evaluation is essential. It also promotes long-distance student collaboration and participation. Students must learn the Gamelan Salendro equipment directly because their learning system only introduces technical aspects of playing without using instruments. However, to introduce the sound of each instrument they learn, students are taught about the sound of each instrument using vocals and Sundanese musical scales.

Keywords: Design thinking, Gamelan salendro, Learning management system, Musical practice, Sundanese musical scale.

## 1. Introduction

This research is based on a phenomenon that occurs in music learning activities, especially the Salendro Gamelan, where students are invited to play gamelan in which various wadiras (instruments) directly exist. Learning like this presents quite complicated problems, apart from the fact that the gamelan facilities do not match the number of students [1, 2]. Many of them need to practice everything taught by the teacher [3]. Apart from that, because the facilities are lacking, it is difficult for them to carry out training activities because they have to queue [1]. With such limitations, learning activities become less effective, and the quality of learning decreases, which could be more un-optimum [4].

Another difficulty experienced by teachers was when the COVID-19 pandemic occurred, and students could not learn face-to-face directly [5-7]. To overcome learning difficulties, researchers created a salendro gamelan learning design with a Learning Management System (LMS). Thus, learning activities no longer depend on the number of facilities adjusted to the number of students but by taking advantage of advances in science and technology.

LMS design can optimize learning evaluation by utilizing digital technology [8-11]. Many reports regarding LMS have been well-documented (see Table 1). This system is designed to accommodate the needs for evaluating Salendro Gamelan's practice by supporting practical and theoretical learning aspects. This innovative approach can combine traditional practice methods with modern technological capabilities. Therefore, the novelty of this research is that there has yet to be a digital evaluation tool for traditional music practice. Hence, the design of the LMS prototype, called the Traditional Class Assessment Information System (SIPKT), is based on KPI, which responds directly to the need for access, which is fair to cultural education and allows a system of assessment and interactive engagement with traditional musical practices, such as Gamelan Salendro.

The activity of learning salendro gamelan by utilizing technological advances is significant, as researchers have done in learning salendro gamelan using LMS and the KPI evaluation system, which has just been carried out. It is said that Salendro's gamelan learning activities have always been oriented towards sounding all gamelan instruments directly to improve psychomotor aspects. Therefore, evaluation activities are usually carried out to directly examine students' skills in playing all gamelan instruments. Some previous reports relating to music education are available [12-16] and detailed information is presented in Table 1.

The purpose of this study was to to resolve discrepancies in applying a Key Performance Indicator (KPI) based assessment system adapted for traditional music practices such as Gamelan Salendro. This system was created specifically for Salendro's Gamelan musical instrument practice classes and aims to objectively measure performance indicators, improve teaching practices, and maintain cultural integrity. The system aims to develop a new generation of practitioners who maintain cultural integrity. This innovative method combines classical teaching ideas with modern technological capabilities. KPI-based approaches provide a comprehensive set of tools for educators, students, and cultural stakeholders. It enables a mutually beneficial relationship between tradition and technological innovation. Previous research can be seen in Table 2.

**Table 1. Previous studies on LMS.**

| No. | Title | Ref. |
|---|---|---|
| 1. | Determinants of learning management system (LMS) adoption by university students for distance learning | [8] |
| 2. | The influence of spada learning management system (LMS) on algorithm learning and programming of first grade students at Universitas Pendidikan Indonesia | [9] |
| 3. | The effectiveness of distance learning using learning management system media and whatsapp groups at senior high school | [10] |
| 4. | The attitude of distance learners towards the utilization of learning management system (A case study of National Open University of Nigeria). | [11] |

This information system prototype is a direct response to the need in the field of cultural studies to promote equal access to cultural heritage through digitalization and distribution of traditional music practices with an easily accessible platform. This information system prototype is a direct response to the need in the field of cultural studies to promote equal access to cultural heritage. This information system allows students to engage with Indonesian culture by digitizing and distributing traditional music practices through an easily accessible and interactive platform. The novelties of this study were (i) digital evaluation for traditional music practice; (ii) the SIPKT prototype is designed using Key Performance Indicators (KPIs); (iii) enhanced accessibility and engagement with traditional musical practices.

**Table 2. Previous studies.**

| No. | Title | Ref. |
|---|---|---|
| 1. | The impact of new technologies on musical learning of Indigenous Australian children | [17] |
| 2. | Pembelajaran gamelan pelog salendro kliningan di Program Studi Musik UPI pada masa pandemi covid-19 | [18] |
| 3. | Pembelajaran mata kuliah gamelan salendro/pelog i dengan menggunakan media audio grafis pada Program Pendidikan Seni Musik UPI | [1] |
| 4. | Performance analysis of MUSIC and LMS algorithms for smart antenna systems | [19] |
| 5. | Identifying significant indicators using LMS data to predict course achievement in online learning | [20] |
| 6. | Efficient computation of key performance indicators in a distance learning university | [21] |
| 7. | Moodle system one of the way to monitoring competence of future teachers of music art | [22] |
| 8. | Key performance indicators to optimize the environmental performance of higher education institutions with environmental management system – A case study of Universitat Politècnica de València | [23] |

## 2. Literature Review

### 2.1. Learning management system (LMS)

An LMS is a software application accessed via the internet that is specifically designed to manage learning content, facilitate student engagement, provide

assessment tools, and provide reports on learning progress and student activities [24-26]. Online learning content is accessed through a LMS, allowing students to view and engage with educational resources via a web browser on any operating system, computer, or mobile device [27, 28]. LMS includes learning systems, course management systems, content management systems, portals, and instructional management systems [29-31]. LMS is an advancement of processes and systems created by universities to register students in specific courses and keep records of their actions [32, 33]. Several educational options have been developed to allow students to enroll in online courses, either as part of an official curriculum or to obtain institutional certification [34-36]. LMS facilitates students in accessing learning materials through course guidelines, submitting assignments, and taking grades [37, 38]. It also allows for active involvement between students and lecturers, as well as between students themselves (see Fig. 1). Additionally, LMS supports interaction between students and learning tools, facilitates knowledge sharing, and enables online exams and quizzes [39].



**Fig. 1**. LMS.

## 2.2. Key performance indicator (KPI)

KPI is measurable indicators to track progress toward specific outcomes [40], where they serve as a focal point for improving strategic and operational processes [41, 42], set the foundation for data-driven decision-making [43], and direct attention to the most critical aspects [44, 45]. Utilizing KPI involves setting performance targets and monitoring progress in achieving those targets. The use of KPI usually focuses on improving performance through the use of leading indicators as early predictors of future success [46], which will then produce the desired results according to the measurements.

In this research, KPI is a measuring tool that describes the effectiveness of practical learning in achieving learning goals in music practice. One way to create relevant KPI is with SMART (specific, measurable, attainable, relevant, time-bound) criteria [47-49] were (i) Specific – Goals or results must be clear and specific; broad

goals or results are not expected. When goals or outcomes are clear and specific, it is easy to know when they have been achieved; (ii) Measurable – Goals or results must be measurable, both in quality and quantity. It can be placed about standard performance or expectations of performance; (iii) Attainable – Achievable, but must be formulated as a challenge and thus will inspire learning to achieve the result or goal; (iv) Realistic – creating an idea where the result or goal must be achieved, but must also be realistic and results-oriented; and (v) Time-bound – each result or goal has a time limit when the goal or result can be achieved (see Fig. 2).
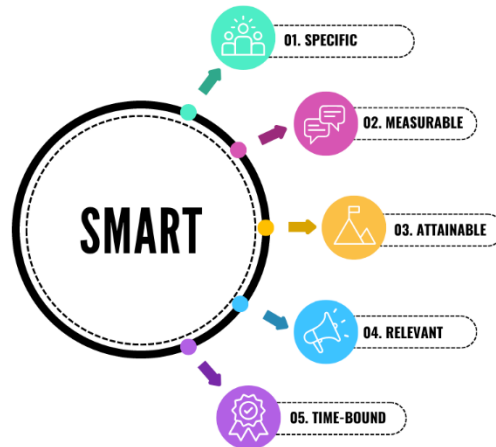


**Fig. 2. SMART KPI.**

### 2.3. Gamelan

Gamelan is the name of a traditional musical ensemble found in several regions of Indonesia, such as West Java (Sunda), Central Java, East Java, Sumatra, and Bali. Gamelan, from one region to another, has differences in tuning (scales), number of waditra (instruments), and playing techniques [50, 51]. In West Java (Sunda), there are several types of gamelan, including gamelan salendro/pelog [52], degung [53], ajeng [54], koromong [55], and gong renteng [56, 57]. From several types of gamelan found in Sunda, only salendro/Pelog and degung gamelan are studied in formal institutions such as Vocational High Schools and Arts Colleges in West Java. One of the higher education institutions that teaches gamelan is the Music Education Study Program, Faculty of Art and Design Education, Universitas Pendidikan Indonesia.

### 2.3.1. Characteristics of Salendro Gamelan material

Almost all salendro gamelan instruments (see Fig. 3) are made of iron and bronze metal with strong and resonant characteristics [58, 59]. Each metallophone in the salendro gamelan is divided into two parts: the penclon (pencu) [60] shaped part and the blade-shaped part [61]. Both in the form of a penclon (pencu) and a blade, there are specifications in terms of tuning/alignment [62, 63]. Lower the tone of a penclon instrument by hitting it at the top and vice versa. Meanwhile, the tip is scraped for the blade, and the middle is scraped to lower the tone.

**Fig. 3. Gamelan salendro instruments.**

### 2.3.2. Sound characteristics of Gamelan Salendro

The salendro gamelan is characterized by a pentatonic scale of five notes per octave. The sound characteristics of the salendro gamelan include a combination of different tuning systems with a diatonic scale and a joyful rhythm because the distance between one note and another has different intervals. Therefore, it is usually called Salendro Bedantara in Sundanese [64], which means different intervals. It can be seen in the following image. Figure 4 shows several different frequencies with diatonic tones, which can be seen in the Table 3.
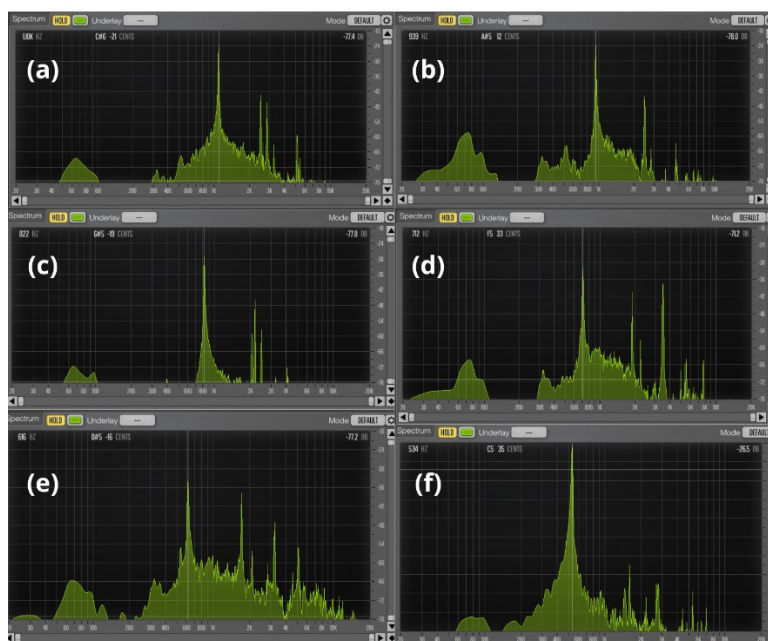


**Fig. 4. Analysis of the tone frequencies in
Gamelan Salendro, namely: (a) High-tone Da (1); (b) Mi (2);
(c) Na (3); (d) Ti (4); (e) La (5); and (f) Low-tone Da (1).**

**Table 3. Interval Gamelan Salendro.**

| No. | Tone | Frequency | Cents | Interval |
|---|---|---|---|---|
| 1. | Da (High-tone) | 1,100 Hz | -21 cents | |
| | | | | 250 cents |
| 2. | Mi | 939 Hz | 12 cents | |
| | | | | 250 cents |
| 3. | Na | 822 Hz | -19 cents | |
| | | | | 196 cents |
| 4. | Ti | 712 Hz | 33 cents | |
| | | | | 300 cents |
| 5. | La | 616 Hz | -16 cents | |
| | | | | 196 cents |
| 6. | Da (Low-tone) | 534 Hz | 35 cents | |

It can be seen from the Table 3 that the intervals in each note are different from each other, the complex tonal and rhythmic patterns in gamelan salendro function as an expression of cosmological and philosophical themes. Gamelan salendro optimizes its acoustics and enhances the overall sound through targeted resonance. Each instrument is carefully tuned to produce a balanced and harmonious ensemble in which no individual instrument takes precedence but contributes to a collective sound that transcends the combined effect of its components.

### 2.3.3. Characteristics of evaluation in Salendro Gamelan learning

The gamelan studied in the FPSD-UPI Music Study Program is only gamelan salendro/pelog and gamelan degung. The gamelan lectures aim to equip students with basic to advanced skills to play the various instruments in the gamelan ensemble. However, based on the author's experience teaching this course, learning gamelan, especially salendro, has never produced maximum learning quality.

Some obligations that students must fulfill are (i) Analysis of the waditra (instrument) technique of playing Salendro Gamelan. Each student must discuss the technique of playing each waditra in the Salendro Gamelan ensemble; (ii) Group formation. Students form groups of six to facilitate collaboration and division of tasks in learning waditra drumming techniques; (iii) Waditra percussion pattern practice. Each group member plays the waditra percussion pattern (instrument) with great technique by imitating the waditra sound well by the standards determined by the educator; (iv) Recorded video products. Each student must send the recorded results of their assignments to their group as material for the teacher's evaluation and assessment; and (v) Combining recorded product results. The group leader, as Person in Charge, is responsible for combining the recordings of each member with the final assessment product in the form of a video.

One of the weaknesses in the salendro gamelan learning activities in the Music Study Program is that the number of learning participants is greater than the number of instruments being studied. Because the number of students studying the instruments is unequal, they must study them in turns. Because these activities are carried out in turns, the lecturer must also explain the material repeatedly.

Also, because it is challenging to get the opportunity to practice the material they have studied, they need to remember what they have learned at the next

meeting at the next meeting. Hence, the lecturer has to repeat it. Facing a situation like this, researchers conducted a trial of learning gamelan using audio graphic media. This media is used to overcome the imbalance between the number of students and the instruments being studied; apart from that, this media is also used to overcome students' difficulties in practicing outside of learning hours.

As a result, students' skills increased, but their mastery of song vocabulary was limited (limited) because the audio they studied was minimal [1]. Therefore, the evaluation was changed from the practice of playing gamelan to playing the technique of playing each instrument using vocals. What is evaluated in this learning is the suitability of the technique played with the notes sounded through the vocals. In this case, all students must play all the instruments in the salendro gamelan with the correct technique and vocals.

## 3. Method

This research uses the Design Thinking method with five stages (see Fig. 5), incuding empathize, define, ideate, prototype, and test [65]. Application of the design thinking method in developing web prototype design concepts to assess key performance indicators for each student who contracts the Salendro Gamelan practice course. In the empathize stage, a process of in-depth understanding of the user allows researchers to understand the needs, desires, and difficulties faced by users of the Salendro Gamelan instrument training assessment system. Define stage, namely, defining the problem clearly and thoroughly. In this case, the aim is to create a comprehensive and efficient assessment system for evaluating music practice learning. The ideate stage is designing ideas and exploring various solutions to overcome identified challenges effectively. The prototype of the assessment system requires the creation of a mock-up that shows the results of student performance with KPI evaluation. The prototype goes through repeated testing by users, in this case, students and educators, to collect input, improve the system, and optimize the system further.
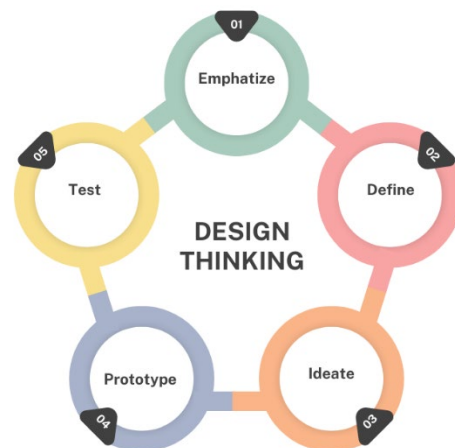


**Fig. 5. Design thinking method.**

This research included 18 students who took the Salendro Gamelan course in the Music Study Program, FPSD UPI, and one lecturer. The data analysis technique

used in this research uses descriptive statistical analysis without making general conclusions or generalizations. The steps carried out by the researcher in analyzing the data were calculating the amount of data obtained from observation data on grades from assignments in the Salendro Gamelan practice course. To calculate the KPI score, use the formula KPI Actual Achievement divided by KPI Target multiplied by 100. The data obtained, and conclusions are then interpreted to determine the achievement of the KPI evaluation. Data is grouped into five scales, namely (i) Very Good (A), if it has 86-100% achievement; (ii) Good (B), if it achieves 70-85%; (iii) Sufficient (C), if it has 50-69% achievement; (iv) Less (D) if it has reached 30-49%; and (v) Very Poor (E), if the achievement is < 30.

## 4. Results and Discussion

### 4.1. Information system design

This Traditional Class Assessment Information System (SIPKT) is designed by utilizing KPI, which consists of several essential components such as user administration, practice scheduling, performance monitoring, feedback and assessment, data analysis, and reporting. This system's evaluation and monitoring process can be seen in Fig. 6.
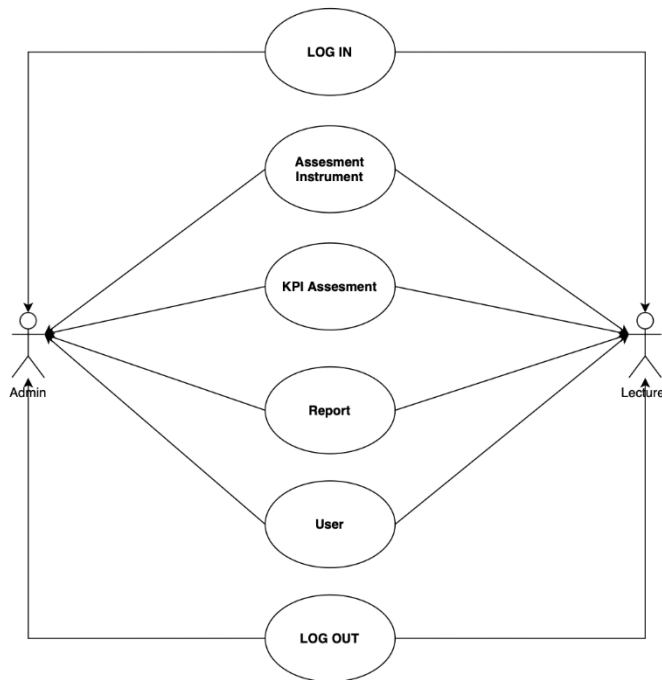


**Fig. 6. Monitoring and evaluation system design.**

Figure 6 shows the flow and interactions in SIPKT to assess the KPI-based Salendro Gamelan practice. In this picture, some responsibilities and procedures must be carried out by users in managing and evaluating student performance. Responsibility scenarios and procedures are shown in Table 4.

**Table 4. User responsibilities and procedures in information systems.**

| | Admin | Lecturer |
|---|---|---|
| **Responsibilities** | Oversee the system, which includes managing user accounts, assessment instruments based on KPI, and reports. | Evaluate student performance, provide feedback, and check reports and assessments created by the system. |
| **Procedure** | Authentication procedures in the system to guarantee the level of security and verification | |
| | Configure assessment instruments to ensure alignment with KPI. | Assess student performance according to the assessment instruments available in the system |
| | Organize input from evaluation instruments that lecturers will use. | Use evaluation instruments to examine aspects of student practice and performance |
| | View and monitor reports on student performance results to make appropriate judgments regarding the music practice process | |
| | Manage the creation, change, and deletion of data. | Manage input of student performance scores. |
| | Logout: Users can safely end their session. | |

## 4.2. SIPKT interface

Developing a KPI-based SIPKT for Gamelan Salendro requires the application of several basic principles of a login system that has been proven effective (see Fig. 7). These principles can be found in the SIPKT, which has a strong and secure user authentication system that ensures only registered users can access the platform. It can be achieved using a simple but helpful login form that enters a username and password protected by encryption and security protocols such as HTTPS. Simple and easy-to-use user interface design ensures that users, including students, teachers, and administrators, can access and feel comfortable.



**Fig. 7. Login panel.**

Role-based access control, which regulates user access according to their role in the system, improves efficiency and security. KPI-based assessments can monitor several essential aspects of Salendro's Gamelan music practice, including

accuracy, timeliness, and musical interpretation. Improving performance by tracking KPI achievements, individual progress, and user data analysis will go a long way. Additional features, such as direct teacher feedback, suggestions for improvement, and educational resources, such as guidebooks and video tutorials, can support traditional music's educational and preservation goals. Therefore, this system is an assessment tool and a platform that serves as an archival and learning resource for the next generation.

The user interface design is intuitive and easy to use, such as displaying icons and text in the "Add Data" and "Search Data" sections, making it easy for users to add and manage student data. The use of engaging and informative visual elements enhances the user experience and ensures high accessibility for various types of users, including instructors, students, and administrators. Thus, effective design contributes to operational efficiency and user satisfaction when using the system.

For the Salendro Gamelan assessment system, SIPKT data visualizations such as pie and bar charts are very relevant. Student assessment indicators such as punctuality, assignment assessment, and student activity in Salendro gamelan learning courses can be used to show student assessment through the KPI Performance diagram (see Fig. 8). With this visualization, teachers can see outstanding student achievements and easily spot student grades that need improvement. It also allows for better communication between teachers and students about their progress and performance.
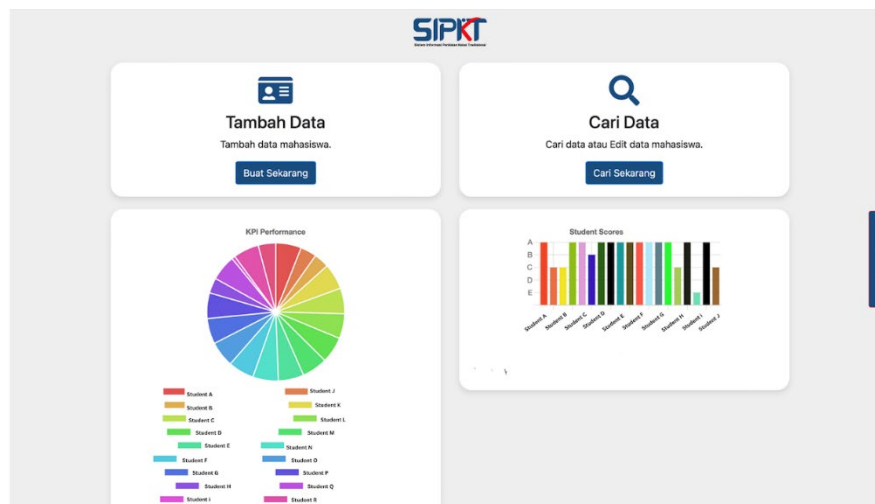


**Fig. 8. Data on student performance.**

The total performance chart (see Fig. 9) allows for in-depth analysis of individual student achievement scores and provides a comprehensive picture of a student's total assessment. It is a handy feature for conducting long-term assessments and observing student progress. With structured historical data, teachers can create better practice programs that meet each student's needs. By providing precise and detailed information about student progress, this feature supports educational goals and can provide constructive feedback.
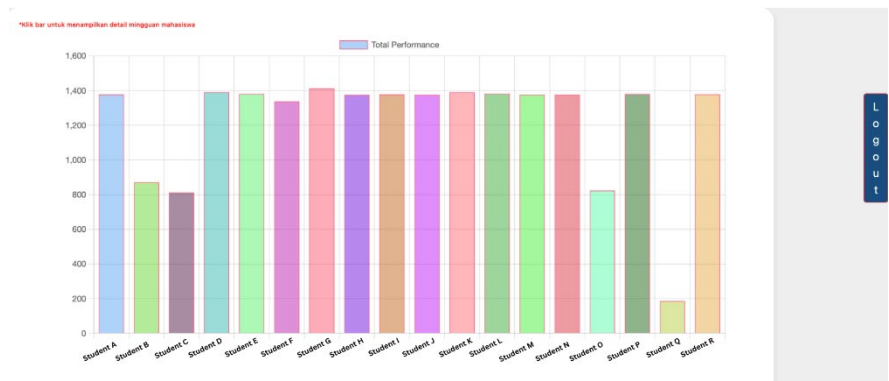
**Fig. 9. Total performance results.**

A diagram like the Fig. 9 produces a more objective and effective assessment tool by combining the KPI system into the Salendro Gamelan music practice assessment system and an educational platform that supports the teaching and learning process. This system will help teachers find and assess student achievement and provide the necessary feedback for student development. Overall, this development diagram supports the goals of education and preservation of traditional music innovatively and sustainably, ensuring that the art of Gamelan Salendro can be inherited and developed by future generations.

Value input in the SIPKT system (see Fig. 10) is straightforward to understand. The system also calculates KPI, which shows student performance in percentage form, and teachers can enter grades from each meeting. The system automatically calculates all grades a student receives. It allows lecturers to make more honest assessments based on complete data.



**Fig. 10. Input dashboard.**

The system displays the total score, KPI in percentage form, and the student's final grade after the scores are entered. In the following illustration, a student

named Dinda has a total score of 198, a KPI of 50.00%, and a grade of C. This process speeds up the assessment and ensures that the student's performance is considered relatively in every aspect.

### 4.3. Performance evaluation on SIPKT

During the evaluation, students must attend and participate in 16 meetings throughout one semester. Each meeting is accompanied by a weekly report, which includes the progress achieved and the work plans of each student.

In Fig. 11, there are five assessment components, namely specific, measurable, attainable, relevant, and time bound. Specific, focuses on defining learning outcomes including (i) primary knowledge about Gamelan Salendro, where students need a comprehensive understanding of the historical, cultural and technical aspects of Gamelan Salendro; (ii) Understanding about Gamelan Salendro, where students understand the practical aspects of playing this musical instrument including proper technique and coordination; (iii) Skills in practicing Gamelan Salendro, which emphasizes the practical skills needed to be proficient in playing Gamelan Salendro, including mastery of instruments, rhythm, and coordination with other students; and (iv) Product, which refers to the actual results of the learning process. In this case, it can be seen from the video recording of students practicing Gamelan Salendro vocally at every meeting.
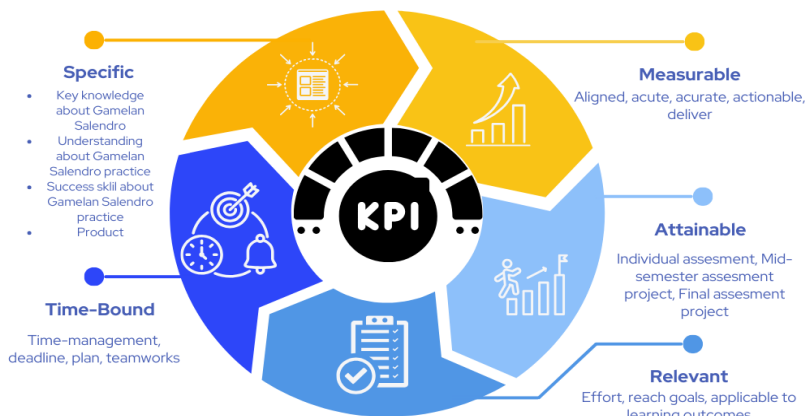


**Fig. 11. KPI assessment elements.**

Measurable, ensuring that learning can be measured to see student progress, including (i) Aligned, where KPI is aligned with learning outcomes from Salendro Gamelan practice courses; (ii) Acute, accurate, actionable, where the matrix used must be precise, correct, and provide clear guidance for improving learning; and (iii) Deliver, refers to the ability to produce products according to specified criteria, such as assessing ability based on student performance in presenting the practice of performing work using specific techniques.

Attainable, where KPI is set to be realistic and achievable with segments including (i) Individual assessment with a regular weekly evaluation of student performance through projects or structured performance; (ii) Midterm exam Project, namely theory and practice assessment in the middle of the semester; and

(iii) Final exam project, the Salendro Gamelan sounds with vocals in the form of videos and technical explanations.

Relevant, which ensures that the objectives are relevant to learning outcomes, includes (i) Effort, namely the efforts made by students in practice and learning; (ii) Reach goals, which help students achieve specific and meaningful goals related to their learning and performance; and (iii) Applicable to learning outcomes, which contribute directly to the desired learning outcomes, and ensure that the assessment is relevant to what students learn.

Time-bound, emphasizing effective time management, includes (i) Time-management as demonstrated by effective management of training time; (iii) Deadlines, which ensure progress and timely completion of practice sessions, assignments, assessments, and resulting projects; (iii Plan, which is structured planning regarding training, project completion, and performance preparation; and (iv) Teamwork, namely collaboration in ensembles, where students can work together effectively.

From the assessment points above, evaluation results are obtained and integrated with the information system being developed. Student performance reports show academic achievement over sixteen assessment periods. Each student is given a total score, KPI in percentage, and the final score is given based on the student's overall ability. This assessment shows students' efforts to get the grades obtained during one semester and helps find students' strengths and weaknesses.

Several students excelled. Student H and Student G had the highest scores overall, each getting a total per meeting of 1412 and a KPI of 88.25%, getting an A. Student K also had an extraordinary score, with a total score of 1390 and a KPI of 86, 88%, each earning an A. Their achievements result from consistent dedication and hard work during class meetings. On the other hand, some students need special attention. Student P has the lowest total score, namely 186, with a KPI of 11.63% and a score of E. Student C and Student B have unsatisfactory scores, in which the total scores obtained were 813 and 872, respectively. the KPI obtained is 50.81 and 54.50%, the grades obtained by both were C. This low score shows that improvement is needed to improve their academic achievement.

The overall class performance showed an average KPI of 76.42%, with most students receiving an A. However, there was variation in the score each semester, with many zero grades in several meetings. It can indicate a problem that needs to be addressed, such as a student's absence from every meeting or difficulty understanding the material being taught. Regarding the results of students' performance from the learning above, they can be seen on YouTube with the title "*Kegiatan Pembelajaran Gamelan Salendro dengan Menggunakan Vokal*" with the link https://www.youtube.com/watch?v=Hj6nRNAkEYM.

### 4.4. Interpretation of results

In developing and using SIPKT in the practical learning of Gamelan, Salendro provides knowledge about education and conservation efforts related to learning this traditional musical instrument. Data obtained from the system provides a complete perspective on student performance growth, as stated in the Student Performance Report. The report results show differences in competency levels among students, as evidenced by their assessments in various performance

sessions. The KPI percentage accurately measures students' overall performance, thus illustrating the usefulness of objective measurements in evaluating their ability to learn Gamelan Salendro. For example, the high KPI achieved by Student A (86.13%) and Student H (88.25%) highlights the effectiveness of regular practice, as seen in the KPI data at each meeting. On the other hand, a lower KPI value, such as for Student B, indicates that specific learning requires additional intervention and support in the learning process.

## 4.5. Relevance of findings

These findings have significant relevance in educational and cultural preservation situations. A KPI-based approach shows precise, actionable data to educators to adjust their teaching tactics from an educational perspective. Using a data-driven approach gives learners precise and focused feedback, thereby improving their overall learning experience. Using consistent assessment criteria across sessions helps ensure impartiality and minimizes potential bias in performance evaluations. This approach ensures the preservation and accurate transmission of Salendro Gamelan techniques and practices in the context of cultural preservation. It is essential to monitor and evaluate students' performance using these procedures to maintain the integrity of the music. This approach also enhances the sustainability and integrity of Gamelan Salendro by offering a well-organized evaluation framework. It can encourage a deeper appreciation and understanding of these traditional arts among the younger generation.

## 4.6. Practical implications

Implementing this KPI-based assessment system establishes a uniform approach to evaluating traditional music practices, thereby enabling their replication in diverse cultural and educational settings. Standardization increases the capacity to compare data from other groups, making it easier to conduct comprehensive analysis and set student benchmarks. Additionally, incorporating technology into conventional music education represents a flexible and adaptable approach to overcoming the difficulties of safeguarding intangible cultural heritage. The system's capacity to store and analyze large amounts of performance data can guide the creation of practice-based curricula and teaching techniques. Technology can also increase the accessibility of traditional music teaching, allowing it to reach a wider audience and increase student engagement. The system incorporates a feedback mechanism that facilitates continuous improvement. Automated feedback, which relies on KPI measurements, allows learners to determine specific areas that need improvement quickly. On the other hand, individual feedback from educators provides different ways to implement these strategies, which will encourage sustainable growth in students.

## 4.7. Assessment limitations

A significant obstacle is dependence on technological infrastructure, where the effectiveness of KPI-based systems is highly dependent on the accessibility and functionality of hardware and software. Implementing such systems in areas with limited access to technology can pose various difficulties. In addition, there is the possibility of facing resistance to changes in traditional musical practices, which are embedded in cultural contexts, and some educators and practitioners consider

the application of technology to be less trustworthy. Another obstacle is that the existing system evaluation criteria may need to comprehensively capture the ins and outs of Gamelan Salendro's performances. Although KPI provides a quantitative performance assessment, they may need to adequately capture the qualitative elements of musical expression, such as conveying emotion and cultural significance. So, additional assessment instrument improvements are needed to target these limitations specifically.

### 4.8. Recommendations for further research

From the results of this research, it is recommended that further research be carried out, namely, improving the system by including broader assessment criteria that include qualitative performance measurements to produce a more comprehensive assessment of students' abilities. It can include peer evaluations, audience feedback, and elements of self-evaluation. Additionally, implementing longitudinal studies to monitor student progress over long periods will provide a deeper understanding of the long-term effectiveness of KPI-based approaches. Research could investigate the influence of regular practice and feedback on student's ability to play traditional musical instruments and their level of engagement with music. This system can maintain cultural relevance and educational effectiveness through collaborative efforts by educators, students, and cultural practitioners. Input from individuals can guide making gradual improvements, thereby increasing the level of system acceptance, engagement, and impact of the system. It is to help maintain and preserve cultural heritage, ensuring the continued prosperity of traditional music, such as Gamelan Salendro, in contemporary society. This paper also adds new information in the education, as reported elsewhere [66-68].

### 5. Conclusion

This research develops an information system for assessing Salendro gamelan music practices based on KPI. This system is designed to evaluate students' performance in musical practice and provide helpful feedback to educators. Traditional music learning with technology has excellent potential to enhance the learning experience. This system functions as an assessment tool and an interactive learning platform with various educational resources, such as guides and videos. Research findings suggest that using technology when assessing traditional music practices can enhance learning and cultural preservation. This system enables a more accurate evaluation of learner performance and offers a platform for continuous learning. It is hoped that the system created can encourage the younger generation to be more interested in and appreciate traditional cultural heritage, ensuring traditional arts such as gamelan salendro for future generations.

### References

1. Supriatna, N. (2023). Pembelajaran mata kuliah gamelan salendro/pelog I dengan menggunakan media audio grafis pada program Pendidikan Seni Musik UPI. *Magelaran: Jurnal Pendidikan Seni*, 6(1), 289-296.
2. Harjanti, F.D.; Ardiansyah, R.; Jarmani, J.; and Indrayana, V.L. (2023). Pengembangan media gamelan digital untuk pembentukkan karakter 5T pada siswa. *Journal of Education Research*, 4(4), 1999-2010.

3.  Sintia, D.E.; and Yanuartuti, S. (2020). Pembelajaran gamelan Jawa menggunakan aplikasi "gatoel" di SMAN 1 Kawedanan Magetan. *Jurnal Pendidikan Sendratasik*, 9(1), 81-94.

4.  Wikantomo, H.; and Wibowo, D.Y. (2022). Meninjau penerapan model pembelajaran gamelan Jawa tingkat sekolah menengah pertama berdasar kurikulum 2013 [Reviewing the implementation of the Javanese gamelan learning model at the junior high school level based on the 2013 curriculum]. *Jurnal Seni Musik*, 12(2), 60-75.

5.  Özüdoğru, G. (2021). Problems faced in distance education during covid-19 pandemic. *Participatory Educational Research*, 8(4), 321-333.

6.  Prasetyo, Y.; and  Amir, A. (2022). Face-to-face learning methods are limited in overcoming students'learning difficulties during the pandemic covid-19. *ETDC Indonesian Journal of Research and Educational Review*, 1(3), 286-296.

7.  Biasutti, M.; Antonini Philippe, R.; and Schiavio, A. (2022). Assessing teachers' perspectives on giving music lessons remotely during the covid-19 lockdown period. *Musicae Scientiae*, 26(3), 585-603.

8.  Soko, Y.; Mpundu, M.; and Yangailo, T. (2024). Determinants of learning management system (LMS) adoption by university students for distance learning. *Indonesian Journal of Educational Research and Technology*, 4(2), 171-186.

9.  Al Husaeni, D.N.; and Hadianto, D. (2022). The influence of spada learning management system (LMS) on algorithm learning and programming of first grade students at Universitas Pendidikan Indonesia. *Indonesian Journal of Multidiciplinary Research,* 2*(*1), 203-212.

10. Agustina, S.; and Nandiyanto, A.B.D. (2021). The effectiveness of distance learning using learning management system media and whatsapp groups at senior high school. *Indonesian Journal of Multidiciplinary Research,* 1(1), 89-98.

11. Ajijola, E.M.; Ogunlade, O.O.; and Aladesusi, G.A. (2021). The attitude of distance learners towards the utilization of learning management system (A case study of National Open University of Nigeria). *Indonesian Journal of Teaching in Scienc*e, 1(1), 53-62.

12. Muliawati, E.S.; and Maryanti, R. (2022). Lyrics of kawih tanah sunda by koko koswara as a media for learning cultural literacy for students in junior high school. *ASEAN Journal of Educational Research and Technology*, 1(2), 133-138.

13. Novrizal, R.S.; Nandiyanto, A.B.D.; Kurniawan, T.; and Bilad, M.R. (2022). The influence of junior high school students' musical preferences on the learning of basic music theory. *Indonesian Journal of Multidiciplinary Research,* 2*(*1), 21-26.

14. Azmiyati, I.; Nandiyanto, A.B.D.; Kurniawan, T.; and Bilad, M.R. (2022). Rhythmical learning program on musical notation for junior high school online using the maestro application. *Indonesian Journal of Multidiciplinary Research,* 2*(*1), 83-90.

15. Syarifatunnisaa, Z.; Zahra, A.T.; Pratiwi, I.R.; Nurazizah, L.I.; Budiman, R.A.; and Kurniawati, L. (2023). Introducing music and movement-based self-therapy for children with cerebral palsy during the covid-19 pandemic. *Indonesian Journal of Community and Special Needs Education*, 2(2), 55-62.

16. Kahar, N.; Abalos, C.A.; Manero, H.N.; Mosquera, D.S.R.; Gonzales, L.B.; Asoy, V.; Estrellan, J.; and Marcell, A.M. (2024). Perceptions of music and its effect on the productivity of students. *ASEAN Journal of Educational Research and Technology*, 3(1), 81-92.

17. Kirkwood, S.; and Miller, A. (2014). The impact of new technologies on musical learning of Indigenous Australian children. *Australasian Journal of Early Childhood*, 39(1), 94-101.

18. Utami, C.P.N.; Supriatna, N.; and Sutanto, T.S. Pembelajaran gamelan pelog salendro kiliningan di program studi pendidikan seni musik UPI pada masa pandemi covid-19. *SWARA*, 2(1), 87-94.

19. Bakhar, M.; Vani, R.M.; and Hunagund, P.V. (2010). Performance analysis of MUSIC and LMS algorithms for smart antenna systems. *titi*, 2(1), 9.

20. You, J.W. (2016). Identifying significant indicators using LMS data to predict course achievement in online learning. *The Internet and Higher Education*, 29, 23-30.

21. Pecori, R.; Suraci, V.; and Ducange, P. (2019). Efficient computation of key performance indicators in a distance learning university. *Information Discovery and Delivery*, 47(2), 96-105.

22. Churikova-Kushnir, O.; Sofronii, Z.; Lisovyi, V.; Postevka, H.; and Niemtsova, L. (2021). Moodle system one of the way to monitoring competence of future teachers of music art. *WSEAS Transactions on Systems and Control*, 16, 439-449.

23. Lo-Iacono-Ferreira, V.G.; Capuz-Rizo, S.F.; and Torregrosa-López, J.I. (2018). Key performance indicators to optimize the environmental performance of higher education institutions with environmental management system–A case study of Universitat Politècnica de València. *Journal of Cleaner Production*, 178, 846-865.

24. Nasser, R.; Cherif, M.; and Romanowski, M. (2011). Factors that impact student usage of the learning management system in Qatari schools. *International Review of Research in Open and Distributed Learning*, 12(6), 39-62.

25. Srichanyachon, N. (2014). EFL learners' perceptions of using LMS. *Turkish Online Journal of Educational Technology-TOJET*, 13(4), 30-35.

26. Ahmadi, G.; Mohammadi, A.; Asadzandi, S.; Shah, M.; and Mojtahedzadeh, R. (2023). What are the indicators of student engagement in learning management systems? A systematized review of the literature. *International Review of Research in Open and Distributed Learning*, 24(1), 117-136.

27. Bogdanović, Z.; Barać, D.; Jovanić, B.; Popović, S.; and Radenković, B. (2014). Evaluation of mobile assessment in a learning management system. *British Journal of Educational Technology*, 45(2), 231-244.

28. Kraleva, R.; Sabani, M.; and Kralev, V. (2019). An analysis of some learning management systems. *International Journal on Advanced Science, Engineering and Information Technology*, 9(4), 1190-1198.

29. Coates, H.; James, R.; and Baldwin, G. (2005). A critical examination of the effects of learning management systems on university teaching and learning. *Tertiary education and management*, 11(1), 19-36.

30. Kim, K.R.; and Moon, N.M. (2013). Designing a social learning content management system based on learning objects. *Multimedia tools and applications*, 64, 423-437.

31. Fariha, Z.; and Zuriyati, A. (2014). Comparing moodle and eFront software for learning management system. *Australian Basic and Applied Sciences*, 8(4), 158-162.

32. Rößling, G.; Joy, M.; Moreno, A.; Radenski, A.; Malmi, L.; Kerren, A.; Naps, T.L.; Ross, R.J.; Clancy, M.; Korhonen, A.; and Iturbide, J.Á.V. (2008). Enhancing learning management systems to better support computer science education. *ACM SIGCSE Bulletin*, 40(4), 142-166.

33. Berking, P.; and Gallagher, S. (2013). Choosing a learning management system. *Advanced Distributed Learning (ADL) Co-Laboratories*, 14, 40-62.

34. Yukselturk, E.; and Yildirim, Z. (2008). Investigation of interaction, online support, course structure and flexibility as the contributing factors to students' satisfaction in an online certificate program. *Journal of Educational Technology & Society*, 11(4), 51-65.

35. Hanna, D.E. (1998). Higher education in an era of digital competition: Emerging organizational models. *Journal of asynchronous learning networks*, 2(1), 66-95.

36. Hollands, F.M.; and Tirthali, D. (2014). Why do institutions offer MOOCs?. *Online Learning*, 18(3), 1-19.

37. Bradley, V.M. (2021). Learning management system (LMS) use with online instruction. *International Journal of Technology in Education*, 4(1), 68-92.

38. Demmans Epp, C.; Phirangee, K.; Hewitt, J.; and Perfetti, C.A. (2020). Learning management system and course influences on student actions and learning experiences. *Educational Technology Research and Development*, 68(6), 3263-3297.

39. Shawar, B.A.; and Al-Sadi, J. (2010). Learning management systems: Are they knowledge management tools?. *International Journal of Emerging Technologies in Learning (iJET)*, 5(1), 4-10.

40. Shahin, A.; and Mahbod, M.A. (2007). Prioritization of key performance indicators: An integration of analytical hierarchy process and goal setting. *International Journal of Productivity and Performance Management*, 56(3), 226-240.

41. Bellisario, A.; Pavlov, A.; and van der Steen, M.P. (2021). The role of performance measurement in aligning operations with strategy: Sustaining cognitive processes of internal alignment. *International Journal of Operations & Production Management*, 41(12), 1879-1907.

42. Karpenko, A.; Karpenko, N.; and Shudrik, O. (2020). Development and implementation of a strategic personnel management system according to goals based on key performance indicators. *Management and Entrepreneurship: Trends of Development*, 2(12), 22-35.

43. Konstas, K.; Chountalas, P.T.; Didaskalou, E.A.; and Georgakellos, D.A. (2023). A pragmatic framework for data-driven decision-making process in the energy sector: Insights from a wind farm case study. *Energies*, 16(17), 6272.

44. Haponava, T.; and Al-Jibouri, S. (2012). Proposed system for measuring project performance using process-based key performance indicators. *Journal of management in engineering*, 28(2), 140-149.

45. Aithal, P.S.; and Aithal, S. (2023). Key performance indicators (KPI) for researchers at different levels and strategies to achieve it. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, 8(3), 294-325.

46. Chan, A.P. (2004). Key performance indicators for measuring construction success. *Benchmarking: an international journal*, 11(2), 203-221.

47. Etgar, D.; and Wibisono, D. (2023). Determining key performance indicators with balanced scorecard approach for construction project warehouse efficiency. *Journal of Economics and Business UBS*, 12(2), 761-776.

48. Desjardins, C. (2021). Don't be too SMART, but SAVE your goals: Proposal for a renewed goal-setting formula for Generation Y. *Journal of Applied Leadership and Management*, 9, 73-87.

49. Amoah, G.B.; and Minishi-Majanja, M.K. (2022). Key performance indicators (KPIs) in Ghanaian university libraries: Developing outcome-based metrics for staff performance. *Performance Measurement and Metrics*, 23(2), 41-52.

50. Weintraub, A.N. (2001). Instruments of power: Sundanese" multi-laras" gamelan in New Order Indonesia. *Ethnomusicology*, 45(2), 197-227.

51. Fausta, E. (2019). Sari Oneng Parakansalak gamelan tuning system and its comparison with Machjar's theory. *International Journal of Visual and Performing Arts*, 1(1), 15-26.

52. Saepudin, A. (2012). Karawitan jaipongan sebagai genre baru dalam karawitan Sunda. *Mudra*, 27(2), 131-140.

53. Novianti, R.; Supriatna, N.; and Karwati, U. Metode tutor sebaya untuk meningkatkan keterampilan siswa dalam memainkan gamelan degung kreasi di SMPN 1 Baregbeg. *SWARA*, 3(2), 63-74.

54. Sekarningsih, E. (2022). Seni karawitan yang mandiri. *Paraguna*, 2(1), 41-57.

55. Sutisna, R.H.; Wiresna, A.G.; and Sukmana, E. (2023). Gamelan koromong dalam konteks ritual 14 mulud pada masyarakat Cikubang Sumedang Jawa Barat. *Resital: Jurnal Seni Pertunjukan*, 24(2), 176-190.

56. Afryanto, S.; Nalan, A.S.; and Rachmadi, G. (2024). Gong rénténg transformation from sacral to profan. *Mudra Jurnal Seni Budaya*, 39(1), 52-60.

57. Ni Made, R. (2018). The essence of rejang renteng performing art for community in Busung Biu village, Buleleng, Bali in global era. *International Journal of Recent Scientific Research*, 9, 26934-26937.

58. Cahyanti, A.; Kurniawan, I.; Kristanto, Y.D.; and Kurniawan, H. (2024). Kajian etnomatematika pada alat musik saron di daerah Yogyakarta. *Jurnal Ilmiah Matematika Realistik*, 5(1), 150-155.

59. Putri, Y.N. (2022). Kreasi gamelan Sorawatu di Desa Girimukti Kabupaten Majalengka: Desain organologi dan komposisi musik. *Swara*, 2(3), 67-80.

60. Ulfa, N.; Meditama, R.F.; and Salim, S. (2023). Pelatihan karawitan sebagai upaya penanaman literasi budaya pada calon guru MI. *Jurnal Edukasi Pengabdian Masyarakat*, 2(1), 60-66.

61. Iswantoro, G. (2018). Kesenian musik tradisional gamelan Jawa sebagai kekayaan budaya bangsa Indonesia. *Jurnal Sains Terapan Pariwisata*, 3(1), 129-143.

62. Arms, J.M. (2021). Tuning "American gamelan": Transforming Javanese gamelan tunings in North America. *Asian Music*, 52(1), 88-120.

63. Saepudin, A. (2015). Laras, surupan, dan patet dalam praktik menabuh gamelan salendro. *Resital: Jurnal Seni Pertunjukan*, 16(1), 52-64.

64. Carterette, E.C.; Kendall, R.A.; and De Vale, S.C. (1993). Comparative acoustical and psychoacoustical analyses of gamelan instrument tones. *Journal of the Acoustical Society of Japan (E)*, 14(6), 383-396.

65. Vetter, R. (1989). A retrospect on a century of gamelan tone measurements. *Ethnomusicology*, 33(2), 217-227.

66. Corrales-Estrada, M. (2020). Design thinkers' profiles and design thinking solutions. *Academia Revista Latinoamericana de Administracion*, 33(1), 9-24.

67. Susilawati, A.; Al-Obaidi, A.S.M.; Abduh, A.; Irwansyah, F.S.; and Nandiyanto, A.B.D. (2025). How to do research methodology: From literature review, bibliometric, step-by-step research stages, to practical examples in science and engineering education. *Indonesian Journal of Science and Engineering*, 10(1), 1.

68. Solihat, A.N.; Dahlan, D.; Kusnendi, K.; Susetyo, B.; and Al-Obaidi, A.S.M. (2024). Artificial intelligence (AI)-based learning media: Definition, bibliometric, classification, and issues for enhancing creative thinking in education. *ASEAN Journal of Science and Engineering*, 4(3), 349-382.