The Concept of *Tumbuk* in Javanese Gamelan Tuning

Harmanto a,1,*, Suyoto b,2, Jody Diamond c,3

a Program Pascasarjana Institut Seni Indonesia (ISI) Surakarta Jl. Ki Hajar Dewantara No. 19 Keningan Jebres Surakarta 57126, Indonesia  
b Karawitan Department, Institut Seni Indonesia (ISI) Surakarta Jl. Ki Hajar Dewantara No. 19 Keningan Jebres Surakarta 57126, Indonesia  
c American Gemelan Institute (AGI), Box 1052, Lebanon, New Hampshire, Unites State of America 03766

* Corresponding Author

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**ABSTRACT**

This study aimed to reveal the concept of *tumbuk* in Javanese gamelan tuning, namely *gamelan ageng* with *Sléndro* and *Pélog*. This study used a qualitative method with an ethnocentric perspective. The data collection was done by conducting literature review, observation, interviews, and studio work, then processed with data analysis. The data analysis then was followed up through data interaction by interpreting the relationship reactions of the three elements of analysis consisting of data collection, data reduction, and data presentation. The interpretation of the data was done inductively, so that the conclusion was drawn entirely from the development of the data according to the realities of the field. The results showed that *tumbuk* was not only limited to a note that has the same high and low, but it is a musical concept that integrates the *Sléndro* and *Pélog* scales in the tuning of a set of gamelans. There are basically only two types of *tumbuk*: nêm *tumbuk* and lima *tumbuk*. Other than those, it means that they are the strut. The thing is, *tumbuk* has a central tone that serves as a benchmark and a supporting tone whose position strengthens the integration of each type of *tumbuk*. As a concept, it was found that *tumbuk* plays several important roles including equalizing the highs and lows of certain notes, equalizing the range of certain notes, and conditioning the range of notes or the addition of the tune.

**KEYWORDS**

Concept of *tumbuk*; Gamelan tuning; *Sléndro*; *Pélog*; Javanese gamelan

**1. Introduction**

The term *tumbuk* is not a novel term among the Javanese, especially for people residing in Central Java – Surakarta. The dictionary of *Bausastr a Jawa* defines the term *tumbuk* as a root word that is equivalent with words like *bêntus,* *têmpuk,* and *gathuk* ‘bumping, colliding, and merging’; it has the meaning of where the exact same day, date, and month repeat themselves – once every eight years. If the term *tumbuk* is given a prefix *di–,* it changes form into *ditumbuk* which then would have the same level with words such as *dibêntus,* *digabrus,* *dibrug,* and *dituntu* which has a literal meaning of *dibentur* or to be hit. However, if it is given a suffix –*an*, it changes form into *tumbukan* which is equivalent to *bêntusan* and *têmpukan*. Therefore the word can then be literally translated as *benturan* or collision. Other than those words mentioned above, *tumbukan* also has other specific meanings; *slamètan nalika tumbuk weleonè* which translates into ‘thanking God when their day, date, and month of birth (in Javanese calendar) are colliding with each other’. The Javanese are prone to celebrating an event where someone has their day, date, and month of birth (in the Javanese calendar) colliding with each other.

*Tumbukan* is a day that is celebrated once every eight years – according to the Javanese calendar. In general, the celebration of this day is marked with the repetition of *pasaran* (in which a week is consisted of only five days according to the Javanese calendar system), date, and month of birth. According to the types, this kind of *tumbukan* can be classified into two: *tumbukan ageng* and *tumbukan alit*. *Tumbukan ageng* is a commemoration day for when someone has reached the age of 64 (eight times of eight years of their lives). Meanwhile, *tumbukan alit* is a celebration for when someone is turning 32 (four times of eight years of their lives) (Marsono, Hendrosaputro, dan Lembaga Studi Jawa 1999).
The term *tumbuk* is also often linked with *karawitan*, a term that is used to refer to a Javanese traditional music ensemble called *gamelan*. Music instruments that are used in *gamelan* are including *Gamélan Klènhèngan, Cökèkan, Gadhon*, and other instruments that are generally categorized into the instruments of *gamelán agèng* (Supanggah, 2002). In one of the regions in Jawa Tengah, Surakarta, also exists a group of instruments namely *gamelán pakurmatan*, in which the instruments are including *Gamélan Carabàlèn, Kodhok Ngòrèk, Monggàng, and Sèkàtèn*. However, generally, the *gamelan* instruments mostly owned by the general public are one of the kinds of *gamelán agèng*. Generally there are two kinds of pangkon in *gamelán agèng*: a pangkon or sèpangkon in *Sléndro* and sèpangkon in *Pélog* (Hastanto, 2009). Generally, *gamelán agèng* has a *tumbuk* among many of the instruments.

Hastanto (2012) stated that a set of gamelan which is tuned in *Sléndro* and *Pélog* is often associated with the concept of *tumbuk*, an activity where *gamelan* players will try to set the *Sléndro* and *Pélog* in the same pitch. For example, the nèm in *Sléndro* has the same sound as the nèm in *Pélog*, therefore said pitch, referred to as pangkon, is called *tumbuk nèm*; likewise, if the pitch is in a lima, that set of gamelan would be referred as *tumbuk lima*. Even though *tumbuk pènunnggul* or *barang*, dhadha, and *gulu* exist in the world of karawitan, most the current general owner of gamelan prefer to own a *tumbuk nèm* gamelan.

After doing a further investigation, turns out, Hastanto, in another source, stated that, generally, the tone of *gulu* *Sléndro* and the tone of *gulu* *Pélog* in a set of *tumbuk nèm* gamelan are also set to collide with each other. This phenomenon is common for skilled pènlaras – the person who tunes the gamelan. Nevertheless, in the hands of skilled pènlaras, this problem would not decrease the beauty of the gamelan’s tune arrangement (Hastanto, 2012).

From a more theoretic perspective, the existence of *tumbuk gulu* which emerges within the surface of *tumbuk nèm* will of course create a misconception about the term *tumbuk* in general. It creates a signal that *tumbuk* is not only about the physical, but also musical phenomenon. It also implies that *tumbuk* is not only a matter of pitch leveling, but instead, it is more of a musical concept that has a strong presence. Therefore, the one thing that needs to be clarified is how *tumbuk* plays its role in the alignment of *gamelán agèng* that is tuned in *Sléndro* and *Pélog*.

The phenomenon illustrates the variety of *tumbuk* and its role before its ability to create interesting yet complex problems to be investigated further. It is such a shame that most of the general public who grow up in the culture of Javanese karawitan only takes *tumbuk* as a physical phenomenon, which is a pitch leveling between *Sléndro* and *Pélog*. This assumption of course reduces the knowledge of *tumbuk* into a “dwarf” knowledge, therefore this problem needs to be urgently addressed. This claim is supported by Wardi, who stated that the growth of the knowledge of karawitan is falling far behind the growth of the artistic aspects of it (Wardi, 2007). A thorough investigation is needed to uncover the real concept of *tumbuk* so there will be no more misconceptions.

**2. Method**

To solve the problems presented, this research used the qualitative research method. Qualitative research is ideal to be used in a scientific condition where the researcher is acting as the key instrument and the data collection is done with a triangulation technique. The result of qualitative research is also more focused on understanding the core of a phenomenon rather than just describing the surface part of it (Aspers & Ugo Corte, 2019). Ngozwana (2018) also emphasized that qualitative research is research that aims to seek an understanding of what is experienced by the research’s subject. With the nature of the method, the researcher can provide an in-depth explanation regarding the essence of *tumbuk* itself.

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1 Specificially, the *karawitan* refers to Karawitan with Surakarta and Semarang style, or one which also known as *semarangan* that is introduced by Ki Narta Saba.
2 Multiple *riçakan* in one gamelan tuning system (*Sléndro* or *Pélog*).
3 The term *pèlog* can be interpreted as a tuning system if written with a capital p (*Pélog*), if the p is written with a lower case (*pèlog*) it can be interpreted as a tune.
4 *Tumbuk pènunnggul* or *barang* was verbally introduced by Hastanto on Wednesday, 6 March 2019 in tegal Asri, Bejen, Karanganyar.
5 The term *barang* can be interpreted as a tuning system if written with a capital B (*Barang*), if the p is written with a lower case (*barang*) it can be interpreted as a tune.

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Therefore, according to the method’s basic principles, the procedures in this research were sequenced into three steps: finding the designated research location, collecting the data, reducing the data, and analyzing the data. A general inductive approach for qualitative data was applied. The emic and etic perspective approach was also used to interpret the data. The emic approach is fully focused on the practitioner’s perspective, while the ethic approach is more focused on the understanding of the data based on logical reasoning (van Oudenhoven, 2017). For example, pitch levels are described as frequencies in the form of numbers (Hastanto, 2016). Despite the quantitative-like data presentation, it does not mean the research’s nature is turning into one of the quantitative kinds. Those numbers are used solely to translate the data for the general public so that they can fully comprehend the provided data. All regions were covered in this research, including Solo Raya. The other covered regions were also including Kota Praja Surakarta, Kabupaten Klaten, and other regions in Java. Solo Raya was chosen as this research’s location according to some considerations. One of which was the scope of this research, which was the tuning of gamelan Jawa, more specifically the tuning of gamelan in Jawa Tengah. The data collected in this research is including the changing of the pitch from one note to another. This particular data is presented with the Hertz (Hz) scale. Meanwhile, the jangkah – an interval structure – from one note to another is presented with the cent scale. The data of this research is also including all musical phenomenon related to tumbuk, the karawitan practitioners’ musical views, concepts, theories, and various definitions related to the tuning of gamelan and the depth of karawitan. To collect all the required data, the researcher used four techniques: literature review, observation, interviews (Table 1), and studio works.

Table 1. List of interviewees

| Name                | Age | Role                                      | Address                                      |
|---------------------|-----|-------------------------------------------|----------------------------------------------|
| Agustinus Damardi  | 40  | gamelan owner                             | Rejos, Jogonalan, Klaten.                    |
| A.L. Suwardi        | 69  | pêngrawit and composer                    | Grogolan VI/9A RT 05/1, Ketelan, Surakarta.  |
| Blacius Subono      | 65  | dalang and gamelan owner                  | Gulon RT 05/XX Kentingan, Jebres, Surakarta. |
| Gatot Purnomo       | 43  | dalang and pêngrawit                      | Sabrang Lor RT 01 RW 28, Mojongo, Jebres, Surakarta |
| Joko Sabean         | 62  | pênglaras                                 | Trucuk, Trucuk, Klaten.                      |
| Panggiyo            | 69  | Pênglaras                                 | RM Hartono No 78 Wirun, Mojolaban, Sukoharjo |
| Purbo Asmoro        | 58  | dalang                                   | Gebang, Kadipiro, Banjarsari, Surakarta.     |
| Rebo                | 70  | pêngrawit and gamelan owner               | Juwono, Dukuh, Tangen, Sragen               |
| Saptono             | 66  | Pêngrawit                                 | Makamhaji, Kartasura, Sukoharjo.             |
| Saroyo              | 43  | pênglaras                                 | Gendengan RT 02/IV, Wirun, Mojolaban, Sukoharjo |
| Sri Mulyanto        | 47  | gamelan owner                             | Sidodadi RT 008 RW 002, Manjung, Sawit, Boyolali |
| Suwito Radyo        | 62  | pêngrawit and gamelan owner               | Sraten RT 05 RW 02, Trunuh, Klaten Selatan, Klaten. |

The analysis of qualitative research was done by using an inductive approach along with inductive reasoning (Woiceshyn & Daellenbach, 2018). In addition, to find the final general statement, the conclusion presented in this research would mostly be in line with facts found in the field. Kiger and Varpio (2020) stated that the inductive approach has a flexible nature, therefore using only a specific theoretical approach instead of utilizing various approaches would only make the presentation of the field data even more unclear. Therefore, the method used to process the field data in this research was not limited to one specific theory, instead, this research depended on the development of the field data and was adjusted to the real situation. The data analysis was done simultaneously with the data collection. The data analysis was done by observing the relationship between the three aspects of data collection, data reduction, and data presentation. After the data was collected, the data were organized according to their categories and units, then a data reduction process was applied. The data reduction
was done by coding. Other than helping in making the data reduction process easier, coding was used to reduce the complexity of data conceptualization. Therefore the data collected can be sorted and categorized according to their correct units. This step was also intended to make sure that the irrelevant data can be stored and be used for other research purposes. The result from these processes is reduced and conceptualized data. To find the pattern or the theme that is in accordance with this research’s purpose, we interpreted the data by analyzing its essence. The specific pattern found was used to formulate conclusions.

3. Results and Discussion

3.1. Tumbuk and its other kinds in the Gamêlan agêng Tuning System

Tumbuk is a musical phenomenon generally found in a set of gamêlan agêng, in which the tune of Slêndro and Pélog are merged. Practitioners usually refer to it as “gathukne laras Slêndro karó Pélog” (combining the tune of Slêndro with Pélog). The physical integration is marked with a central absolute pitch that is posing as a base for tumbuk. As an example, if nêm is used as the base tune during the merge, nêm Slêndro and nêm Pélog will have to be in an absolute pitch as a sign that both of the tunes are characterized as laras tumbuk nêm.

However, not only central notes, but there are also supporting notes in a relatively similar pitch which has the role of giving a stronger force to the merge. From this explanation, we can see the lack of understanding of the concept of tumbuk. This explanation only addresses the physical aspects of tumbuk, which is the similarity of the pitch, and not the essence of tumbuk as a whole. This lack of understanding is addressed by Hastanto in his explanation provided in the previous chapter. In addition, Supanggah, in Bothekan Karawitan II: Garap (Supanggah, 2009) and Sutton in Traditions of Gamelan Music in Java: Musical Pluralism and Regional Identity (Sutton, 1991) also have similar views about tumbuk. Ironically, these kinds of physical-aspects-only explanations are still being used by Risanandar in his book – “Pelarasan Gamelan Jawo” – (Risanandar, 2018).

We know that practitioners and the public are familiar with the various kinds of tumbuk in the tuning system of gamelan, such as tumbuk pênunggul, gulu, dhadha, etc. However, no matter what pitch they used to tune the gamelan, they will refer to them all as tumbuk nêm or tumbuk lima. It is not uncommon for them to treat tumbuk nêm or tumbuk lima as the main term for this phenomenon. This term also has commonly been used among practitioners such as Saroyo, Saptono, Subono, Purbo Asmoro, etc. For instance practitioners will say: “gamélan e tumbuk nêm, oh lune ya tumbuk” (if it is a tumbuk nêm gamelan, the dhadha is also tumbuk) “gamélan e tumbuk lima, oh jinê ya tumbuk” (if it is a tumbuk lima, then the pênunggul is also tumbuk).

From the explanation, it is apparent that the term tumbuk mentioned in this particular sentence – tumbuk nêm or tumbuk lima – has a different meaning from the term mentioned in this sentence – tumbuk dhadha or tumbuk pênunggul. Tumbuk nêm is posing as the central note that acts as the basis of other kinds of tumbuk, while tumbuk dhadha is merely posing as the supporting element. This applies to the position of tumbuk lima and tumbuk pênunggul as well. Therefore, not all tunes that possess the same pitch in the tuning of a set of gamélan agêng with Slêndro and Pélog can be referred to as central notes that bases every other kind of tumbuk.

The data collected in the field also provide some details that it is not common for the tuning of gamélan agêng to have only one set of pitches. Even so, nêm or lima is never absent from one of the absolute pitches. Therefore, in the tuning of gamélan agêng with Slêndro and Pélog, tumbuk nêm and tumbuk lima are the only two kinds of tumbuk that can pose as central notes and the base of other tumbuk. The other kinds of tumbuk can only act as a supportive tune to give a stronger force to the merge process. This explanation will be discussed further in the analysis chapter.

3.2. The Form and Role of Tumbuk in the Gamêlan Agêng Tuning System

Tumbuk is a musical concept that is expressed through the merge of the Slêndro and Pélog tune in a set of gamélan agêng. The merge of the two tunes is a result of the penglaras – gamelan tuner – thoughts and ideas about how the concept of tumbuk is presented to the public. Without their thoughts and ideas, there might some distortions in the explanation of the role of tumbuk. This is in line with what Widodo stated in his book; that the Javanese always utilize their feelings to understand the
melodies presented in karawitan. It is proven from the fact that karawitan training process is also never absent from using the kupingan method – from “Implementation of Kupingan Method in Javanese Karawitan Music Training for Foreigners” – (Widodo et al., 2021). Hastanto also emphasized that empirical practices are vital for the building of various artistic theoretical concepts.

Practitioners such as Saroyo, Pangiyo, A.L Suwardi, and Joko Sabean informed that in the merging of the Sléndro and Pêlog tunes, they used tumbuk in some important parts. Those important parts were including the leveling of a particular pitch, the leveling of a particular jangkah, and conditioning the range of the tunes. This role applies to both tumbuk nêm and tumbuk lima (cited from interviews, 22 December 2017; 12 April 2019; 15 April 2019; 4 April 2019).

Further, those statements from practitioners are the first step to understand the role of tumbuk through the investigation of the tuning of gamêlan agêng with Sléndro and Pêlog. This research observed a set of gamêlan agêng with the best quality. The set of gamelan was then compared with a set of gamêlan agêng tumbuk nêm in Klaten and a set of gamêlan agêng tumbuk lima in Surakarta.

### 3.2.1. Klaten The Role of Tumbuk Nêm in the Gamêlan agêng Klaten’s Tuning System

A set of gamêlan agêng tumbuk nêm owned by Agustinus Damardi is one of the sets that has the best quality among many others in Klaten. Not to mention the creation of the set was based on the recommendation given by respected pêngrawit (gamelan players) who hold the title of êmpu such as Suwito, Gatot Purnomo, and many others. Therefore, it is not an exaggeration to say that the gamelan set really served the best quality and is worthy to be the subject of investigation.

For the tunes in the gamêlan agêng’s tuning system essentially refers to the ricikan of gender barung, the focus of this research’s analysis will be on the teba (register) of the tunes. However, to see more of the consistency and the significance of the tunes, this process was also done to accommodate the tune combination between sub tunes Pêlog Bêm and Pêlog Barang, with Pêlog as the alternative tune.

The tune register of ricikan gender barung in Sléndro, sub tunes Pêlog Bêm and sub tunes Pêlog Barang is placed in the second, third, fourth, and fifth gêmbyang (octave). Meanwhile, the tune register of ricikan slenthem, demung, and saron barung in Sléndro are placed in the second, third, fourth, fifth, and sixth gêmbyangan. For the tune register of ricikan slenthem, demung, and saron barung in Pêlog, the register is placed in the third, fourth, and fifth gêmbyangan. The register in every ricikan is presented into tables that can be seen on Table 2 to Table 5.

**Table 2.** The register of gêmbyang in gender barung Sléndro

| Gêmbyang | II | III | IV | V   |
|----------|----|-----|----|-----|
| Nada     | nm | pn  | gl | dd  |
|          | lm | nm  | pn | gl  |
|          | dd | lm  | nm | pn  |
| Gender Barung |   |     |    |     |

**Table 3.** The register of gêmbyang in gender barung Pêlog Bêm

| Gêmbyang | II | III | IV | V   |
|----------|----|-----|----|-----|
| Nada     | nm | pn  | gl | dd  |
|          | lm | nm  | pn | gl  |
|          | dd | lm  | nm | pn  |
| Gender Barung |   |     |    |     |

**Table 4.** The register of gêmbyang in gender barung Pêlog Barang

| Gêmbyang | II | III | IV | V   |
|----------|----|-----|----|-----|
| Nada     | nm | br  | gl | dd  |
|          | lm | nm  | br | gl  |
|          | dd | lm  | nm | br  |
| Gender Barung |   |     |    |     |
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Table 5. The register of gêmbyang in slenthem, demung, and saron barung Slêndro.

| Gêmbyang | II | III | IV | V | VI |
|----------|----|-----|----|---|----|
| Nada     | nm | pn  | gl | dd | lm | nm  | pn  | gl | dd | lm | nm  | pn  |
| Slêndro  |     |     |    |    |    |     |     |    |    |    |     |     |
| Demung   |     |     |    |    |    |     |     |    |    |    |     |     |
| Saron Barung | | | | | | | | | | | | |

Notes: the dark grey colored pitches on saron barung would be analyzed, meanwhile the light grey colored pitches would be the overall display, likewise the pitches on saron barung in Pêlog scale. Furthermore, the pitches on sarung baron in Pêlog scale would also be given the same treatment.

Table 6. The register of gêmbyang in slenthem, demung, and saron barung Pêlog

| Gêmbyang | III | IV | V |
|----------|-----|----|---|
| Nada     | pn  | gl | dd | pl | lm | nm | br | pn  | gl | dd | pl | lm | nm | br |
| Slêndro  |     |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Demung   |     |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Saron Barung | | | | | | | | | | | | | | |

Table 7 to Table 9 are each of the tuning systems for every ricikan. It can be seen how tumbuk nêm played the role of integrating Slêndro and Pêlog tuning systems in the gamêlan agêng Klaten, where the investigation would be carried out starting from gender barung.

Table 7. The frequency, jangkah, and ambah-ambahan of the tuning system or the tone range in gender barung Slêndro

| Gêmbyang | II | III | IV | V |
|----------|----|-----|----|---|
| Tone Name | Nm | Pn  | Gl | Dd | Lm | Nm | Pn  | Gl | Dd | Lm | Nm | Pn  | Gl | Dd |
| Frequency (Hz) | 117 | 132 | 153 | 177 | 203 | 235 | 265 | 305 | 340 | 376 | 408 | 440 | 472 | 512 |
| Jangkah (Cent) | 208 | 255 | 252 | 237 | 253 | 208 | 243 | 258 | 246 | 252 | 213 | 233 | 265 | 117-712 Hz |
| Range | | | | | |

Table 8. The frequency, jangkah, and notes range in gender barung Pêlog Bêm

| Gêmbyang | II | III | IV | V |
|----------|----|-----|----|---|
| Tone Name | Nm | Pn  | Gl | Dd | Lm | Nm | Pn  | Gl | Dd | Lm | Nm | Pn  | Gl | Dd |
| Frequency (Hz) | 117 | 149 | 161 | 175 | 219 | 236 | 298 | 322 | 349 | 397 | 439 | 473 | 512 | 602 |
| Jangkah (Cent) | 419 | 134 | 144 | 388 | 129 | 404 | 134 | 139 | 397 | 129 | 417 | 130 | 146 | 117-706 Hz |
| Range | | | | | |

Table 9. The frequency, jangkah, and notes range in gender barung Pêlog Barang

| Gêmbyang | II | III | IV | V |
|----------|----|-----|----|---|
| Tone Name | Nm | Br  | Gl | Dd | Lm | Nm | Br  | Gl | Dd | Lm | Nm | Br  | Gl | Dd |
| Frequency (Hz) | 116 | 129 | 162 | 175 | 219 | 236 | 262 | 323 | 351 | 383 | 438 | 474 | 474 | 529 |
| Jangkah (Cent) | 184 | 394 | 134 | 388 | 129 | 181 | 362 | 144 | 383 | 137 | 190 | 351 | 148 | 116-706 Hz |
| Range | | | | | | | | | | | | | | | |
It can be seen from the pitch level on Table 7, Table 8, and Table 9 that the nèm pitch in Sléndro, Pélog Bèm, or Pélog Barang in each of the gèmbyangan are on the same frequency. It shows that the frequency of the second gèmbyang on pitch nèm Sléndro was on 117 Hz, on Pélog Bèm is also on 117, and Pélog Barang is on 116 Hz; the frequency in the third gèmbyang on pitch nèm Sléndro is on 235 Hz, Pélog Bèm and Pélog Barang are also both on 236 Hz; lastly, the frequency of the fourth gèmbyang on pitch nèm Sléndro is on 472 Hz, Pélog Bèm is on 473 Hz, and 474 Hz is on Pélog Barang. Indeed, several frequencies were made in plêng or exactly the same Hz, while several others are slightly shifted with a 1-2 Hz gap.

Regarding this matter, pènglaras said that these differences can still be accepted, as they were regarded as having the same frequency by the Javanese karawitan culture. Agreeing on this matter, Hastanto (2012) stated about semi absolute pitch, in which shifting pitch in Javanese karawitan with the limit of below 10 Hz is accepted. Thus, except for the pitch in nèm Sléndro and Pélog in each gèmbyangan are on the same frequency, also other pitches are categorized to be on the same frequency.

On the third gèmbyang, pênunggul Sléndro and barang Pélog Barang can be said to be on the same frequency. Other than that, gulu Sléndro also sits on the same frequency with pènunggul Pélog Bèm together with gulu Pélog Bèm and Pélog Barang. Furthermore, dhadha Sléndro, Pélog Bèm, and Pélog Barang are also on the same frequency.

A similar frequency between other pitches was still happening on the fourth gèmbyang. It is stated that pènunnggul Sléndro was categorized in the same frequency with barang Pélog Barang. Likewise, gulu Sléndro, although they no longer share the same frequency with either gulu Pélog Bèm or Pélog Bèm, is still on the same frequency with pènunnggul Pélog Bèm. Furthermore, dhadha Sléndro, dhadha Pélog Bèm, and Pélog Barang share the same frequency. This phenomenon also applies for the fifth gèmbyang.

In the previous discussion, the tuning system of tumbuk nèm on gender barang was analyzed from the frequency of the pitches. Moving on to the next topic, the main focus would be on the jangkah of tumbuk nèm on gender barang. Unless an observation of certain parts provided a significance result, all the range of gèmbyangan will be thoroughly observed.

From the three tables, it can be seen that the jangkah between the second gèmbyang nèm and in the third gèmbyang pènunnggul Sléndro was in 208 cent, meanwhile, the jangkah on the second gèmbyang nèm and in the third gèmbyang barang Pélog Barang was in 184 cent. Thus, there was a slight difference between both jangkah which can be considered as having the same interval number. The similar interval between the pitch does not have to be made exactly the same (plêng) since the other pitches with similar frequencies are also not made as such. Therefore, logically, the frequencies and the jangkah will always receive a same exact treatment in terms of being a plêng.

If observed thoroughly, the combination of the jangkah from the second nèm gèmbyang, and the third gulu gèmbyang of Sléndro is around 400 cent, which does not go beyond 500 cent. Therefore, it can be said that this jangkah is almost the same with the jangkah between the second gèmbyang nèm and the third gèmbyang pènunnggul of Pélog Bèm which has 400-500 cent of interval. This similarity also occurs in the third pènunnggul gèmbyang and the third dhadha gèmbyang of Pélog Bèm with an approximately 200-300 cent of interval.

The similarity of the jangkah between certain pitches in Sléndro and Pélog tuning system showed a consistent pattern. This means the jangkah between the pitches in both Sléndro and Pélog tuning systems were consistently similar in every gèmbyangan.

Aside from analyzing the frequency and the jangkah of each note, the analysis of ambah-ambahan in the tuning system was also crucial. Based on the three tables above, it can be seen that the lowest pitch of Sléndro was 117 Hz, 117 Hz for Pélog Bèm, and 116 Hz for Pélog Barang. While the highest pitch was 712 Hz for Sléndro, 706 Hz for Pélog Bèm, and 706 Hz also for Pélog Barang. Thus, it can be concluded that the three tuning systems are equal in terms of ambah-ambahan.

Further discussions would be analyzing the tuning system in ricikan slenthem, demung, and saron barang which will be presented in the table 10 and table 11.
would be observing the tuning system on the used by students. April 2019; 10 April 2019). The statement is supported by the fact that t Asmoro, and others, the quality of the gamelan’s tuning system was good (cited from interviews, 15 located in t Solo Raya area, but luckily, we were able to lay our hands on one. In this research, one set of 3.2.2. Based on this analysis, it can be conclu the same number as the interval. Furthermore, in the same gêmbyang, the same frequencies. The similarity also happens in the third frequency. On the third gêmbyang, the third gêmbyang was the only pitch that has a similar frequency. On the third gêmbyang, it can be seen that gulu Sléndro and pênunggul Pélog were having the same frequencies. The similarity also happens in the third gêmbyang of gulu Sléndro and the third gêmbyang of gulu Pélog tuning system. In addition, frequencies in third dhadha gêmbyang of both Sléndro and Pélog systems are also the same. Furthermore, the frequency of third gêmbyang lima of Sléndro is the same as the third Pélog gêmbyang of Pélog.

Meanwhile, pitches that have similar frequencies in the fourth gêmbyang are including the pitches in pênunggul Sléndro and barang Pélog, gulu Sléndro and pênunggul Pélog, dhadha Sléndro and dhadha Pélog, and last, lima Sléndro and Pélog Pélog. Meanwhile, in the fifth gêmbyang, pitches that have similar frequencies are including the pitches in pênunggul Sléndro and barang Pélog, gulu Sléndro and pênunggul Pélog, and lastly, dhadha Sléndro and dhadha Pélog. Likewise, the three tables would be analyzed according to the jangkah between each pitch. The analysis would also be carried out according to needs.

According to the tables above, it is clear that the jangkah between the gulu and dhadha in the third gêmbyang in Sléndro system is around 200-300 cent, which is considered similar with the jangkah between the third pênunggul and dhadha of gêmbyang in Pélog. In addition, it is almost the same as the jangkah between the third dhadha and Pélog of gêmbyang in Pélog, which also has the same interval. Furthermore, in the same gêmbyang, the jangkah between lima and nêm Sléndro is having the same number as the jangkah between the Pélog and nêm Pélog, which is around 200-300 cent. Based on this analysis, it can be concluded that the jangkah between the pitches in all gêmbyangan in both Sléndro and Pélog systems are consistently the same.

3.2.2. The Role of Tumbuk Lima in the Gamelan agêng Surakarta’s Tuning System

Nowadays, the gamêlan agêng set which uses the tumbuk lima tuning system is hardly seen in the Solo Raya area, but luckily, we were able to lay our hands on one. In this research, one set of gamêlan agêng tumbuk lima that would be analyzed was from ISI Surakarta. The gamelan set was particularly located in the C3 room of Puppetry Department of ISI Surakarta. According to A.L Suwardi, Purbo Asmoro, and others, the quality of the gamelan’s tuning system was good (cited from interviews, 15 April 2019; 10 April 2019). The statement is supported by the fact that the set is still actively being used by students.

The same procedure would be carried out correspondingly to the previous analysis. The first step would be observing the tuning system on the ricikan in gender barung, which then would be continued

| Table 10. The frequency and jangkah between tonees in sléndro, dhadha, and saron barung Sléndro |
|---------------------------------------------------------------|
| Gêmbyang | II | III | IV | V |
| Tone Name | Nm | Pn | Gl | Dd | Lm | Nm | Pn | Gl | Dd | Lm | Nm | Pn | Gl | Dd |
| Frequency (Hz) | 118 | 133 | 153 | 178 | 203 | 235 | 265 | 305 | 354 | 407 | 472 | 539 | 611 | 711 |
| Jangkah (Cent) | 207 | 242 | 262 | 227 | 253 | 208 | 243 | 258 | 241 | 256 | 230 | 217 | 262 |

| Table 11. The frequency and jangkah between tonees in sléndro, dhadha, and saron barung Sléndro |
|---------------------------------------------------------------|
| Gêmbyang | III |
| Tone Name | Pn | Gl | Dd | Pl | Lm | Nm | Br |
| Frequency (Hz) | 149 | 162 | 176 | 206 | 220 | 236 | 262 |
| Jangkah (Cent) | 145 | 143 | 272 | 212 | 121 | 181 | 223 |

| Gêmbyang | IV | V |
| Tone Name | Pn | Gl | Dd | Pl | Lm | Nm | Br | Pn | Gl | Dd |
| Frequency (Hz) | 298 | 323 | 350 | 410 | 439 | 474 | 529 | 603 | 649 | 707 |
| Jangkah (Cent) | 139 | 139 | 274 | 118 | 133 | 190 | 227 | 129 | 148 |

Based on Table 10 and Table 11, it can be seen that nêm is not the only pitch that has a similar frequency. On the third gêmbyang, it can be seen that gulu Sléndro and pênunggul Pélog were having the same frequencies. The similarity also happens in the third gêmbyang of gulu Sléndro and the third gêmbyang of gulu Pélog tuning system. In addition, frequencies in third dhadha gêmbyang of both Sléndro and Pélog systems are also the same. Furthermore, the frequency of third gêmbyang lima of Sléndro is the same as the third Pélog gêmbyang of Pélog.

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with observing the other ricikan. The form of the tuning system is presented in the table 12, Table 13, and Table 14.

Table 12. The frequency, jangkah, and notes range in gender barung Sléndro

| Gêmbyang | II      | III     | IV      | V       |
|----------|---------|---------|---------|---------|
| Tone Name | Nm | Pn | Gl | Dd | Lm | Nm | Pn | Gl | Dd | Lm | Nm | Pn | Gl | Dd |
| Frequency (Hz) | 122 | 140 | 161 | 184 | 212 | 243 | 282 | 323 | 370 | 424 | 488 | 567 | 649 | 744 |
| Jangkah (Cent) | 238 | 242 | 231 | 245 | 236 | 258 | 235 | 235 | 235 | 236 | 260 | 234 | 236 |
| Range | | | | | | | 122-744 Hz |

Table 13. The frequency jangkah, and notes range in gender barung Pêlog Bêm

| Gêmbyang | II | III | IV | V |
|----------|----|-----|----|---|
| Tone Name | Nm | Pn | Gl | Dd | Lm | Nm | Pn | Gl | Dd | Lm | Nm | Pn | Gl | Dd |
| Frequency (Hz) | 110 | 140 | 152 | 166 | 211 | 226 | 284 | 307 | 333 | 425 | 453 | 568 | 620 | 677 |
| Jangkah (Cent) | 417 | 142 | 152 | 415 | 119 | 395 | 135 | 141 | 422 | 110 | 392 | 152 | 152 |
| Range | | | | | | | | 110-677 Hz |

Table 14. The frequency, jangkah, and notes range in gender barung Pêlog Barang

| Gêmbyang | II | III | IV | V |
|----------|----|-----|----|---|
| Tone Name | Nm | Br | Gl | Dd | Lm | Nm | Br | Gl | Dd | Lm | Nm | Br | Gl | Dd |
| Frequency (Hz) | 111 | 122 | 152 | 167 | 211 | 227 | 246 | 307 | 333 | 424 | 451 | 495 | 618 | 675 |
| Jangkah (Cent) | 164 | 381 | 163 | 405 | 126 | 139 | 383 | 141 | 418 | 107 | 161 | 384 | 152 |
| Range | | | | | | | | 111-675 Hz |

The first step was observing the frequency of the pitches. It can be seen in Table 12, Table 13, and Table 14 that lima Sléndro, Pêlog Bêm, and Pêlog Barang are on the same frequency in every gêmbyang. Not only on lima, but the other pitches are also seen to have the same frequency with others. Starting from the second gêmbyang, nêm Sléndro and barang Pêlog Barang that have the same frequency. Likewise, gulu Sléndro and dhadha Pêlog Bêm and Pêlog Barang are also showing the same frequency. Even though the similarity only possibly occurs in the third gêmbyang, gulu Sléndro is having the same frequency as gulu Pêlog Bêm and Pêlog Barang.

A thorough observation found that some pitches in Sléndro and Pêlog system have a consistently similar frequency in almost every gêmbyang; except one. Gulú pitches in both tuning systems, Sléndro and the two sub tunes of Pêlog, only happen to have the same frequency in the third gêmbyang.

The next discussion is the observation of the jangkah between the pitches. From the three tables, it can be seen that in the third gêmbyang between pênunggul and gulu Sléndro there is 200-300 cent jangkah. This number is similar to the jangkah found between pênunggul and dhadha Pêlog Bêm which is also around 200-300 cent. On the other hand, in the third gêmbyang, the jangkah between gulu and lima Sléndro is 400-500 cent which is similar to the jangkah between dhadha and lima Pêlog Bêm and Pêlog Barang. Still, in the same gêmbyang, the jangkah between the lima and nêm Sléndro is 200-300 cent, which is similar to the jangkah between lima in the third gêmbyang and barang in the fourth gêmbyang Pêlog Barang.

It can be concluded that first; the jangkah between pênunggul and gulu Sléndro with the jangkah between pênunggul and dhadha Pêlog Barang did not show the tendency of having similar jangkah.
in the fifth gêmbyang, which resulted in a relative similarity of each jangkah between the pitches. Second; except for the case on the first point, all of the gêmbyangan has a similar jangkah between the pitches in the Sléndro and Pêlog system.

The next discussion would be about the range of the pitches. Based on Table 12, the lowest pitch in Sléndro system is 122 Hz, while the highest is 744 Hz. Meanwhile, the lowest pitch in Pêlog Bem is 110 Hz, while the highest is 677 Hz. Last, the lowest pitch in Pêlog Barang system is 111 Hz and the highest is 675 Hz. Based on these findings, the three systems did not have an equal ambahan, in which the Sléndro system tends to be higher among the three.

To further analyze the consistency and significance, an observation on the ricikan sléndro, demung, and saron barang was carried out. Below were the tables that presented the findings. Based on Table 15 and Table 16, it can be seen that lima pitches in both Sléndro and Pêlog systems are in the same frequency, likewise the other pitches. In the third gêmbyang, pênunggul Sléndro and Pêlog are made in plêng. In addition, gulu Sléndro and Pêlog are in the same frequency although it only occurs in the third gêmbyang; likewise with dhadha Pêlog. Another similarity is found in the same gêmbyang, which is dhadha Sléndro and Pêlog Pêlog. In addition, nêm Sléndro and barang Pêlog also share the same frequency.

Table 15. The frequency and jangkah between tonnes in ricikan sléndro, demung, and saron barang Sléndro

| Gêmbyang | II | III | IV | V |
|----------|----|-----|----|---|
| Tone Name |Nm|Pn|Gl|Dd|Lm|Nm|Pn|Gl|Dd|Lm|Nm|Pn|Gl|Dd|
| Frequency (Hz) |122|140|161|185|212|243|283|324|371|425|488|566|651|746|
| Jangkah (Cent) |238|242|241|236|236|264|234|234|235|239|257|242|236|

Table 16. The frequency and jangkah between tonnes in ricikan sléndro, demung, and saron barang Sléndro

| Gêmbyang | III |
|----------|-----|
| Tone Name |Pn|Gl|Dd|Pl|Lm|Nm|Br|
| Frequency (Hz) |140|152|165|194|212|227|246|
| Jangkah (Cent) |142|142|280|154|118|139|243|

| Gêmbyang | IV | V |
|----------|----|---|
| Tone Name |Pn|Gl|Dd|Pl|Lm|Nm|Br|Pn|Gl|Dd|
| Frequency (Hz) |283|307|333|391|424|451|496|568|620|677|
| Jangkah (Cent) |141|141|278|140|109|165|235|152|152|

From the findings, it can be concluded that; first, the similarity in the frequency of dhadha Sléndro and Pêlog Pêlog only occurred in the third gêmbyang, which characterized as relative. It also applied to the similarity between gulu Sléndro and gulu Pêlog. Second, the similarity in frequency between gulu Sléndro and dhadha Pêlog was also relative since it did not occur in the fifth gêmbyang. Third, except for the first and second points, the similar frequency in other pitches is found to be consistent in all gêmbyangan.

The next discussion would be about the jangkah. Based on the tables, the jangkah between pênunggul and gulu Sléndro is 200-300 cent, likewise the jangkah between pênunggul and dhadha Pêlog. Thus, the jangkah between pitches in Sléndro tuning system is considered the same as Pêlog.

Moreover, the jangkah between lima and nêm in the third gêmbyang Sléndro is 200-300 cent, likewise the jangkah between lima and barang in the third gêmbyang Pêlog. In other pitches, the jangkah between nêm in the third gêmbyang and pênunggul in the fourth gêmbyang Sléndro is also around 200-300 cent, along with the jangkah between barang and pênunggul in the fourth gebmbyang.
Meanwhile, the pitches range or between jangkah in both scales was found to be similar in other gêmbayan, which means that the pitches were consistent.

4. Conclusion

According to the previous discussions, it can be concluded that, First, there were only two kinds of tumbuk in a gamelan tuning system, which were tumbuk nêm and tumbuk lima. Thus, anything aside from those two were considered the basic pitches that only supported them. Second, tumbuk was much more than a pitch scale between Sléndro and Pélog; it also plays the role of the synchronizer in frequencies and jangkah between pitches, and also the coordinator of pitch or ambah-ambahan in the tuning system. Third, there were much more complicated matters regarding frequencies in tumbuk nêm than in tumbuk lima. The pitches which have the same frequencies in tumbuk nêm were nêm Sléndro and nêm Pélog, pênunggul Sléndro and barang Pélog, and many others. While tumbuk lima has pênunggul Sléndro and pênunggul Pélog, lima Sléndro and lima Pélog, etc. The similar jangkah between pitches in tumbuk nêm were the jangkah between nêm and pênunggul Sléndro and the jangkah between nêm and barang Pélog, and many others. Meanwhile, in tumbuk lima were the jangkah between pênunggul and gulu Sléndro and the jangkah between pênunggul and dhadha Pélog (especially in the lower gêmbayan), the jangkah between gulu and lima Sléndro and the jangkah between dhadha and lima Pélog (especially in the lower gêmbayan too), and many others. Meanwhile, the pitches range or ambah-ambahan tuning system tumbuk nêm was equal, while tumbuk lima was not.

References

Aspers, Patrik, and Ugo Corte. 2019. "What is qualitative in qualitative research." Qualitative sociology, Vol. 42, no. 2, pp. 139-160.

Hastanto, Sri. 2009. Konsep pathêt dalam karawitan Jawa. Cetakan pertama. Surakarta: Program Pascasarjana bekerja sama dengan ISI Press Surakarta.

Hastanto, Sri. 2011. Kajian Musik Nusantara-1. Cetakan pertama. Surakarta: ISI Press Solo.

Hastanto, Sri. 2012. Kajian Musik Nusantara-2. Surakarta: ISI Press Solo.

Hastanto, Sri. dkk. 2016. Kehidupan Laras Slendro Di Nusantara. Karanganyar: Citra Sains.

Kiger, Michelle E., and Lara Varpio. 2020. “Thematic analysis of qualitative data: AMEE Guide No. 131.” Medical teacher, vol. 42, no. 8, pp. 846-854.

Marsono, Waridi Hendrosaputro, dan Lembaga Studi Jawa, ed. 1999. Ensiklopedi kebudayaan Jawa. Yogyakarta: Yayasan Studi Jawa, Lembaga Studi Jawa.

Ngozwana, Nomazulu. 2018. “Ethical Dilemmas in Qualitative Research Methodology: Researcher’s Reflections.” International Journal of Educational Methodology, vol. 4, no. 1, pp. 19-28.

van Oudenhoven, Jan Pieter. 2017. "Emic and etic research." The International Encyclopedia of Intercultural Communication: 1-7.

Risnandar. 2018. “Pelarasan Gamelan Jawa.” Dewa Ruci, Vol 13 No 2. https://doi.org/10.33153/dewaruci.v13i2.2508.

Supanggah, Rahayu. 2002. Bothekan Karawitan I. Jakarta: Ford Foundation & Masyarakat Seni Pertunjukan Indonesia.

Supanggah, Rahayu. 2009. Bothekan Karawitan II: Garap. Surakarta: Program Pascasarjana bekerja sama dengan ISI Press Surakarta.
Sutton, R. Anderson. 1991. *Traditions of Gamelan Music in Java: Musical Pluralism and Regional Identity*. Cambridge: Cambridge UP.

Waridi, ed. 2007. *Hasil Simposium Karawitanologi*. Surakarta: ISI Press, Institut Seni Indonesia Surakarta.

Widodo. 2015. “Laras in Gamelan Music’s Plurality.” *Harmonia: Journal of Arts Research and Education*, Vol 15, No 1. https://doi.org/10.15294/harmonia.v15i1.3695.

Widodo, dkk. 2021. “Implementation of Kupingan Method in Javanese Karawitan Music Training for Foreigners.” *Harmonia: Journal of Arts Research and Education*, Vol 21, No 1. https://doi.org/10.15294/harmonia.v21i1.29993.

Woiceshyn, Jaana, and Urs Daellenbach. 2018. “Evaluating inductive vs deductive research in management studies: Implications for authors, editors, and reviewers.” *Qualitative Research in Organizations and Management: An International Journal*. 