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The Concept of *Tumbuk* in Javanese Gamelan Tuning

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ABSTRACT

This study aimed to reveal the concept of *tumbuk* in Javanese gamelan tuning, namely *gamêlan agêng* with *Sléndro* and *Pélog*. This study used a qualitative method with an ethical emic 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 *Bausastra 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 *ditutu* 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 *têmpuk*. Therefore the word can then be literally translated as *benturan* or collision. Other than those words mentioned above, *tumbukan* also has other specific meanings; *slamêtan nalika tumbuk wetoné* 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 agêng* and *tumbukan alit*. *Tumbukan agêng* 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).

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The term *tumbuk* is also often linked with *karawitan*[1], a term that is used to refer to a Javanese traditional music ensemble called *gamelan*. Music instruments that are used in *gamelan* are including *Gamêlan Klênèngan, Cokèkan, Gadhon,* and other instruments that are generally categorized into the instruments of *gamêlan agêng* (Supanggah, 2002). In one of the regions in Jawa Tengah, Surakarta, also exists a group of instruments namely *gamêlan pakurmatan,* in which the instruments are including *Gamêlan Carabalèn, Kodhok Ngorèk, Monggang,* and *Sêkatèn.* However, generally, the gamelan instruments mostly owned by the general public are one of the kinds of *gamêlan agêng.* Generally there are two kinds of *pangkon* in *gamêlan agêng*: a *pangkon*[2] or *sêpangkon* in *Sléndro* and *sêpangkon* in *Pélog*[3] (Hastanto, 2009). Generally, *gamêlan agêng* 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 *nêm* in *Sléndro* has the same sound as the *nêm* in *Pélog,* therefore said pitch, referred to as *pangkon,* is called *tumbuk nêm*; likewise, if the pitch is in a *lima,* that set of gamelan would be referred as *tumbuk lima*. Even though *tumbuk pênunggul*[4] or *barang*[5], *dhadha,* and *gulu* exist in the world of *karawitan,* most the current general owner of *gamelan* prefer to own a *tumbuk nêm 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 nêm* gamelan are also set to collide with each other. This phenomenon is common for skilled *pênglaras – the person who tunes the gamelan*. Nevertheless, in the hands of skilled *pênglaras,* 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 nêm* 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 *gamêlan agêng* 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 Waridi, who stated that the growth of the knowledge of *karawitan* is falling far behind the growth of the artistic aspects of it (Waridi, 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.

[1] Spesifically, the *karawitan* refers to Karawitan with Surakarta and Semarang style, or one which also known as *semarangan* that is introduced by Ki Narta Sabta.

[2] Multiple *ricikan* in one gamelan tuning system (*Sléndro* or *Pélog*).

[3] The term *pélog* can be interpreted as a tuning system if written with a capital p (*Pélog*), if the p is written with a lower case (*pélog*) it can be interpreted as a tune.

[4] *Tumbuk pênunggul* 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 scoop 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	Rejoso, 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*	Kanggungan RT 1 Rw 7, Jl. Lettu 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

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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 *Sléndro* and *Pélog* are merged. Practitioners usually refer to it as "*gathukne laras Sléndro karo Pélog*" (combining the tune of *Sléndro* 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 Sléndro* 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 Risnandar in his book – "*Pelarasan Gamelan Jawa*" – (Risnandar, 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: "*gamêlan e tumbuk nêm, oh luné ya tumbuk*" (if it is a *tumbuk nêm* gamelan, the *dhadha* is also *tumbuk*) "*gamêlan e tumbuk lima, oh jiné 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 *gamêlan agêng* with *Sléndro* and *Pélog* can be referred to as central notes that bases every other kind of *tumbuk*.

The data collected in the field also provides some details that it is not common for the tuning of *gamêlan 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 *gamêlan agêng* with *Sléndro* 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 *Sléndro* and *Pélog* tune in a set of *gamêlan 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

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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, Panggiyo, A.L Suwardi, and Joko Sabean informed that in the merging of the *Sléndro* and *Pélog* 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 *Pélog*. 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, the sub tunes would also be analyzed. The sub tunes are the melodies present in *ricikan slenthem*, *demung*, and *saron barung*. Other than being used to determine the consistency and significance of the tunes, this process was also done to accommodate the tune combination between sub tunes *Pélog Bêm* and *Pélog Barang*, with *Pélog* as the alternative tune.

The tune register of *ricikan gender barung* in *Sléndro*, sub tunes *Pélog Bêm* and sub tunes *Pélog 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 *Pélog*, 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	gl	dd
Gender Barung														

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

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

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

Gêmbyang	II	III					IV					V		
Nada	nm	br	gl	dd	lm	nm	br	gl	dd	lm	nm	br	gl	dd
Gender Barung														

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Table 5. The register of gêmbyang in slenthem, demung, and saron barung *Sléndro*.

Gêmbyang	II	III					IV					V					VI
Nada	nm	pn	gl	dd	lm	nm	pn	gl	dd	lm	nm	pn	gl	dd	lm	nm	pn
Slenthem																	
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 *Pélog* scale. Furthermore, the pitches on *sarung baron* in *Pélog* scale would also be given the same treatment.

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

Gêmbyang	III							IV							V						
Nada	pn	gl	dd	pl	lm	nm	br	pn	gl	dd	pl	lm	nm	br	pn	gl	dd	pl	lm	nm	br
Slenthem																					
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 *Sléndro* and *Pélog* 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 Sléndro*

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	354	408	472	534	611	712
Jangkah (Cent)		208	255	252	237	253	208	243	258	246	252	213	233	265
Range	117-712 Hz													

Table 8. The frequency, *jangkah*, and notes range in *gender barung Pélog 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	439	473	602	649	706
Jangkah (Cent)		419	134	144	388	129	404	134	139	397	129	417	130	146
Range	117-706 Hz													

Table 9. The frequency, *jangkah*, and notes range in *gender barung Pélog 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	438	474	529	648	706
Jangkah (Cent)		184	394	134	388	129	181	362	144	383	137	190	351	148
Range	116-706 Hz													

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It can be seen from the pitch level on Table 7, Table 8, and Table 9 that the *nêm* pitch in *Sléndro, Pélog Bêm,* or *Pélog Barang* in each of the *gêmbyangan* are on the same frequency. It shows that the frequency of the second *gêmbyang* on pitch *nêm Sléndro* was on 117 Hz, on *Pélog Bêm* is also on 117, and *Pélog Barang* is on 116 Hz; the frequency in the third *gêmbyang* on pitch *nêm Sléndro* is on 235 Hz, *Pélog Bêm* and *Pélog Barang* are both on 236 Hz; lastly, the frequency of the fourth *gêmbyang* on pitch *nêm Sléndro* is on 472 Hz, *Pélog Bêm* 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, *pênglaras* 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 *nêm Sléndro* and *Pélog* in each *gêmbyangan* are on the same frequency, also other pitches are categorized to be on the same frequency.

On the third *gêmbyang, 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 *pênunggul Pélog Bêm* together with *gulu Pélog Bêm* and *Pélog Barang*. Furthermore, *dhadha Sléndro, Pélog Bêm,* and *Pélog Barang* are also on the same frequency.

A similar frequency between other pitches was still happening on the fourth *gêmbyang.* It is stated that *pênunggul 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 Bêm* or *Pélog Bêm,* is still on the same frequency with *pênunggul Pélog Bêm.* Furthermore, *dhadha Sléndro, dhadha Pélog Bêm,* and *Pélog Barang* share the same frequency. This phenomenon also applies for the fifth *gêmbyang*.

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

From the three tables, it can be seen that the *jangkah* between the second *gêmbyang nêm* and in the third *gêmbyang pênunggul Sléndro* was in 208 cent, meanwhile, the *jangkah* on the second *gêmbyang nêm* and in the third *gêmbyang 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 *nêm gêmbyang,* and the third *gulu gêmbyang* 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 *gêmbyang nêm* and the third *gêmbyang pênunggul* of *Pélog Bêm* which has 400-500 cent of interval. This similarity also occurs in the third *pênunggul gêmbyang* and the third *dhadha gêmbyang* of *Pélog Bêm* 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 *gêmbyangan.*

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 Bêm,* and 116 Hz for *Pélog Barang.* While the highest pitch was 712 Hz for *Sléndro,* 706 Hz for *Pélog Bêm,* 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 barung* which will be presented in the table 10 and table 11.

ISSN 1412-4181,
eISSN 2685287X

Table 10. The frequency and jangkah between tonees in slenthem, demung, 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 slenthem, demung, 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	114	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*.

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 Gamêlan 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

ISSN 1412-4181,
eISSN 2685287X

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	236	243	260	234	236
Range	122-744 Hz													

Table 13. The frequency *jangkah*, and notes range in *gender barung Pélog 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 Pélog 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*, *Pélog Bêm*, and *Pélog Barang* are on the same frequency in every *gêmbyangan.* 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 Pélog Barang* that have the same frequency. Likewise, *gulu Sléndro* and *dhadha Pélog Bêm* and *Pélog 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 Pélog Bêm* and *Pélog Barang.*

A thorough observation found that some pitches in *Sléndro* and *Pélog* system have a consistently similar frequency in almost every *gêmbyangan;* except one. *Gulu* pitches in both tuning systems, *Sléndro* and the two sub tunes of *Pélog*, 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 Pélog 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 Pélog Bêm* and *Pélog 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 Pélog Barang.*

It can be concluded that first; the *jangkah* between *pênunggul* and *gulu Sléndro* with the *jangkah* between *pênunggul* and *dhadha Pélog Barang* did not show the tendency of having similar *jangkah*

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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 *Pélog* 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 *Pélog Bêm* is 110 Hz, while the highest is 677 Hz. Last, the lowest pitch in *Pélog Barang* system is 111 Hz and the highest is 675 Hz. Based on these findings, the three systems did not have an equal *ambah-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 slenthem*, *demung*, and *saron barung* 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 *Pélog* systems are in the same frequency, likewise the other pitches. In the third *gêmbyang*, *pênunggul Sléndro* and *Pélog* are made in *plêng.* In addition, *gulu Sléndro* and *Pélog* are in the same frequency although it only occurs in the third *gêmbyang*; likewise with *dhadha Pélog*. Another similarity is found in the same *gêmbyang*, which is *dhadha Sléndro* and *Pélog Pélog*. In addition, *nêm Sléndro* and *barang Pélog* also share the same frequency.

Table 15. The frequency and *jangkah* between tonnes in ricikan *slenthem, demung, 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)	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 tonees in ricikan *slenthem, demung, and saron barung 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 *Pélog Pélog* only occurred in the third *gêmbyang*, which characterized as relative. It also applied to the similarity between *gulu Sléndro* and *gulu Pélog.* Second, the similarity in frequency between *gulu Sléndro* and *dhadha Pélog* 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 Pélog*. Thus, the *jangkah* between pitches in *Sléndro* tuning system is considered the same as *Pélog*.

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 Pélog*. 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*

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Pélog. Hence, the *jangkah* between pitches in both *Sléndro* and *Pélog* shared the same number. In observing the similarities in *jangkah* between the pitches in both *Sléndro* and *Pélog* tuning system on the *tumbuk lima,* we found several important points. First, the *jangkah* between *pênunggul* and *gulu Sléndro* was found to have differences with the *jangkah* between *pênunggul* and *dhadha Pélog* in the fifth *gêmbyang,* but also found to be similar in other *gêmbyang*, which means that the pitches were relative. Second, aside from the first point, the *jangkah* between pitches in both scales was found to be similar in other *gêmbyangan*, 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 *gêmbyangan*), the *jangkah* between *gulu* and *lima Sléndro* and the *jangkah* between *dhadha* and *lima Pélog* (especially in the lower *gêmbyangan* too), and many others. Meanwhile, the pitches range or *ambah-ambahan* tuning system *tumbuk nêm* was equal, while *tumbuk lima* was not.

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