The Taishōgoto: A Japanese Stringed Musical Instrument of Nagoya

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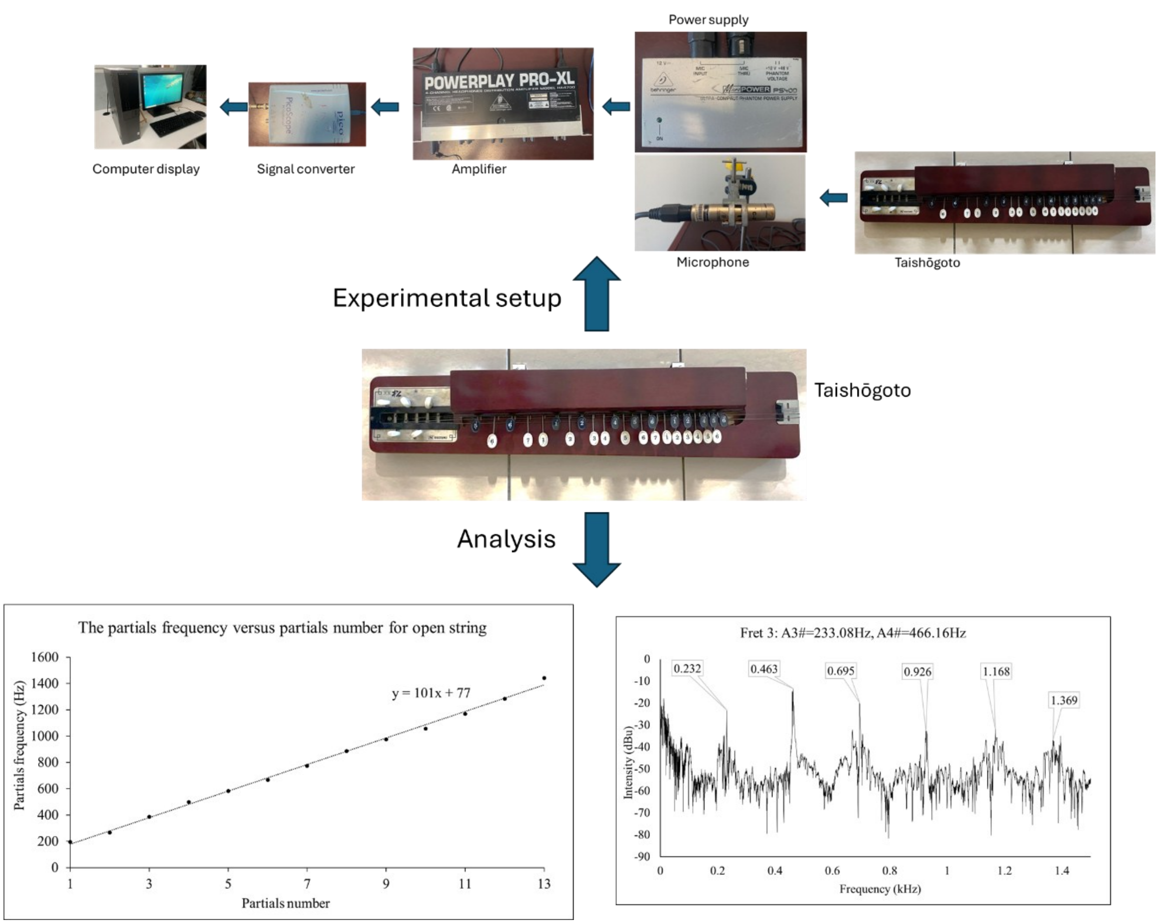
DOI: 10.15376/biores.21.1.606-620

GRAPHICAL ABSTRACT



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A taishōgoto is a Japanese instrument that combines a guitar and an autoharp with the scale buttons positioned in a piano-like pattern. Its unique design, which combines a strung zither body with a keyboard mechanism akin to a typewriter, makes it relatively easy to achieve precise pitch while generating a rich, bright timbre full of overtones. For open string, the gradient of the partials frequency *versus* the partials indicates the value of 100.95 (*i.e.*, G2) is half the fundamental frequency *i.e.*,195 Hz (*i.e.* G3). For harmonicity (fn/f0) *versus* the partials number, the gradient of ~0.5 shows that the partials consist of the harmonic and in-harmonics partials. For fret 3, the gradient of the partials frequency *versus* the partials is 229.46 (*i.e.*, A3#), equivalent to the fundamental frequency (f0) of 232 Hz (A3#). The taishogoto regardless finds practical applications in spite of these limitations. It has been evolved into a variety of genres, such as jazz, world, and folk music, and it continues to be of interest to experimental composers who are experimenting with its unique tonal characteristics. The taishogoto thus has a special place between usefulness and artistry, history and modernity, and innovation and limitation.

DOI: 10.15376/biores.21.1.606-620

Keywords: Taishōgoto; Fast Fourier Transform (FFT); Harmonics

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INTRODUCTION

After returning to Japan, musician and skilled instrument maker Gorō Morita began creating a portable musical instrument that shared some mechanics with a typewriter. The goal was to provide a low-cost way for Japanese people to perform western music (Ward 2018). Organology (2025) states that it was developed during the Taishō period with the goal of bridging the gap between Western and Japanese musical traditions by being easy to learn and perform. Its keyboard-like interface democratized music-making by enabling solo and ensemble performances by people with little to no professional expertise. The instrument is culturally associated with nostalgia and group music-making, and it is frequently found in schools, community centers, and family gatherings. Its tone highlights both the beauty of traditional Japanese music and the joyous experimentation of modern innovation.

It is supposed to have been inspired by the koto-like two-stringed nigenkin. Additionally, Morita was typically inspired to create this instrument by zither-type instruments. Morita initially referred it as the kiku koto, but later changed it to taishōkoto (sometimes called taishōgoto) because of its association with the koto and homage to Emperor Taishō. The Taishō period (1912 to 1926) was followed by the creation of Taishōgoto. The zither-like hollow body of the instrument, which is always strummed, has a series of numbered keys that are pressed against the strings to change their pitch. The early original instrument only had two strings; however, the contemporary Japanese rendition usually has six (Ward 2018). Its original construction was similar to that of the autoharp, a stringed instrument of the zither family commonly used to accompany western, folk, and country music, according to Encyclopedia Britannica. The musician can sit with the instrument on their lap or on a table. This instrument continues to attract amateurs in Argentina, India, Japan, and Hawaii. Similar to the taishōgoto, the German akkordolia and the Indian bulbul tarang both use keys to press down on strings to change pitch. It is comparable to the Swedish nyckelharpa in some ways, but it differs greatly in the motion and method of playing the strings. The Krautrock band Harmonia played the instrument in the 1970s.

It progressively became quite popular as an amateur instrument during the later Taishō era, especially among young people who thought it was a respectable way to perform Western music. It became less popular in the years preceding World War II and was forgotten in the country until the 1970s, when it became popular again and was marketed to middle-aged ladies in particular (Ward 2018).

The Taishogoto's automated fretting mechanism is a special key system that resembles a typewriter. A metal bar presses the string against the fretboard when a key is pressed with the left hand, reducing the vibrating length of the string and increasing the pitch. This enables the musician to choose chords or notes without fretting the strings directly. Sound is produced by the right hand strumming the strings close to the bridge using a pick. This design combines the performance of a stringed instrument with the mechanics of a typewriter, making it simple to play both complex melodies and chords. The structure of the taishōgoto combines a guitar and an autoharp. Typically, it has five strings, three of which are tuned to the same note (before pressing any of the keys of the instrument, *i.e.*, open-string tuning), one of which is tuned an octave lower (open-string tuning), and the other is two octaves lower (open-string tuning).

When a lever that looks like a typewriter key is pressed above each fret, the first four strings are fretted at that note, leaving the lowest string untapped. The open string in this specific instrument was eliminated to enable it to be played in several keys without retuning. The conventional way to play the taishōgoto is to use the left hand to control the notes using the typewriter key while the right hand is strumming the strings with a pick. The taishōgoto already has a fretting mechanism built in, unlike the majority of stringed instruments, such as guitars. The taishōgoto scale buttons are its primary distinguishing characteristic. The numbers on the scale buttons and the finger that presses the button are both represented by numerical notations in the taishōgoto music sheet. Even people who are not able to understand staff notation may play it easily. There are several ways to play, such as adding vibrato and tremolo, as well as picking on the backstroke. Tremolo is mostly produced on the taishogoto by strumming with the right hand while choosing notes or chords with the left hand by pressing keys. The most popular method is using a pick to produce a smooth, continuous sound by rapidly alternating down-up strokes while maintaining a relaxed wrist. Single-direction tremolo is an alternate technique that produces a harsher, more percussion-like effect by rapid, repeated downstrokes. In order to create a shimmering, prolonged harmony, tremolo can also be applied to chords by rapidly strumming all of the strings while holding down a chord key with the left hand. To avoid tiredness, players should keep their movements small and controlled, strum near the bridge for a bright tone, and increase the pace gradually through slow practice.

In East Africa, the instrument has also gained naturalization and is frequently referred to as taishōgoto (Albiez and Pattie 2011). In essence, it is a multi-stringed keyboard psalmodikon. The soprano version has five or six strings, the alto version has four or five, and the tenor and bass version have one or two. The drone strings are tuned to D, while the melody strings are set to G. The akkordolia from Germany, the bulbul tarang from India, and the benju from Pakistan all use keys to press down on strings to alter their pitch, and the taishōgoto is very similar to all of these instruments. For the same reason, it is somewhat similar to the Swedish nyckelharpa, despite the fact that the action and technique of playing the strings are extremely different. Both Harmonia and the Krautrock group Neu used the instrument on their debut album in 1972 (George 2023). Taishōgoto's sounds is similar to other metallic string instruments such as the dulcimer, as well as to a guitar or harp. All five strings-including the drone or simply the four strings can be played. Pressing the buttons on a typewriter machine with the left hand is similar to plucking the strings between the frets with the left hand on a guitar. With at least four strings that vibrate subtly differently, this instrument always plays as a span of two octaves. It creates a tone reminiscent of medieval fantasy.

The taishōgoto's scale buttons are its primary distinguishing characteristic. Simply put, the note will be released if you pick the string with your right hand while holding down a scale button with your left. The instrument must be tuned in order to produce the sound like a guitar, bass, or mandolin. Figure 1 shows the arrangement of the strings.

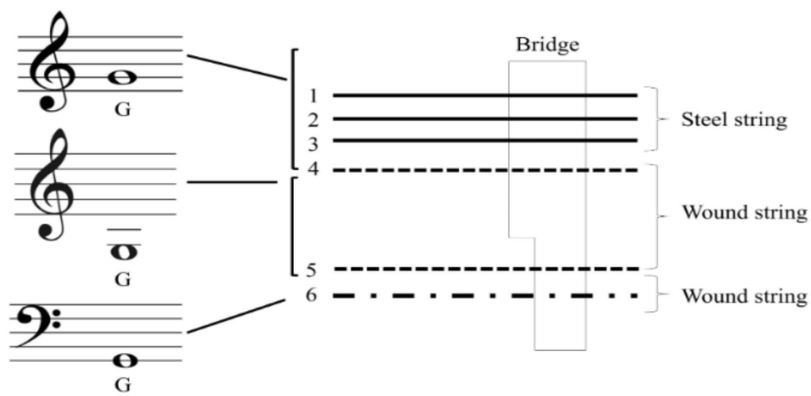

Fig. 1. The arrangement of the strings

Like other stringed instruments, the taishōgoto has a string winder, or genmaki. (Somehow, it is not referred to as a peg.) To tune the instrument and change the string tension, the string winder is turned. The peculiarity is that they all have the same G sound, yet the tuning process is the same as for other instruments. The first through third strings are all tuned to the same G. The fourth string is tuned to G one octave lower than the first, second and third string. The fifth string is tuned to G one octave lower the fourth string. Instruments used for courtly and folk repertoires in Japan underwent a dramatic technological reimagining in the first decades of the twentieth century, around the same time that Japan developed and implemented methods of producing artificial pearls, which resulted in the decline of pearl diving in the Gulf. This was due to the new cultural and industrial vistas inaugurated during the Meiji Restoration (Mürer 2023, p. 134). The koto plucked zither was redesigned with fewer strings and fitted with typewriter-style keys as a fretting mechanism and named the taishōgoto, thereby celebrating the Tashi period for this surge in innovation (Jinko 1986; Charles 1994, 101; Malm 2000, 194; Johnson 2003, n. 3).

To commemorate this period of innovation, the koto plucked zither was modified with fewer strings and equipped with typewriter-style keys as a fretting mechanism. The taishōgoto had a certain novelty appeal and had spread to ports along the coast of the Indian Ocean by the middle of the 20th century. It was dubbed benjū, after the banjo, when it arrived in South Asia. (The instrument has kept its name, taishōgoto, in Swahili contexts in Tanzania and Kenya, where it is employed as a musical element somewhat sparingly.

It is composed of one (or sometimes two) drone strings and a course of three (or four) melody strings that are fretted using a kind of keyboard arrangement. Compared to the melody strings, the drone string or strings' bridge is lower. In octaves, the melody strings are tuned to G. The fretboard's range includes a high G (G4), the G below middle C (G3 or G2), an octave lower than the melody strings, G (G1) is the tuning of the drone string or strings. While single-string playing is feasible to play only the lower or higher octave, the melody strings are often strummed to play all three strings. Playing more than one note on the melody strings at once is not possible. Both the numbers on the scale buttons and the finger that presses them are indicated numerically in the taishōgoto's music score. Even people who cannot understand staff notation may play it easily because of this. For soprano taishōgoto, the usual tuning is g'g'g', using g and G, as drones. The top three strings (which should all have the same gauge) should be in a high octave. The tuning for that should be all G's. All the open strings of this instrument, by default, are all G. Basso in lower G, tenor (1 octave up the basso), soprano (2 octave up, the basso). With a G tuning of a 5-string instrument, the upper strings are G4, then G3 for the octave down and G2 for the bass string.

The harmonic series has a fundamental relationship with timbre, which is the perceived quality or character of a musical sound. The overtones or other frequencies that resonate with the fundamental are determined by the harmonic series, which is a sequence of frequencies that are integer multiples of the fundamental frequency. Each instrument has a distinct timbre that is determined by the presence, absence, and relative intensity of certain overtones in the harmonic series. A musical instrument does more than simply vibrate at the fundamental frequency when it makes a note. Additionally, it produces overtones or harmonics when it vibrates at multiples of that frequency. What makes one instrument sound different from another is the particular pattern of these overtones and how loud they are. Another name for timbre is tone color or tone quality. Timbre is distinct from pitch, rhythm, and volume and can be described in a variety of ways. Brightness or darkness is one of the most widely used terms to define timbre in relation to an instrument's frequency range. The timbre is perceived as darker when there are more overtones. The timbre of the musical instrument is considered as having a brighter tone when there are fewer audible overtones.

The wood of *Paulownia* is smooth with even grain and makes it suitable for use in decorative applications such as furniture and musical instruments. The well-known sound-deadening properties of *Paulownia* wood make it suitable for use in environments such as recording rooms and music studios where sound insulation is essential. Because of its excellent dimensional stability, *Paulownia* wood does not considerably expand or contract in response to changes in humidity and temperature. This makes it the ideal material to employ in applications where dimensional stability is essential, including as flooring, furniture, and musical instruments. *Paulownia* wood's excellent acoustics make it suitable for use in soundproofing and musical instruments. This is due to wood's low density and excellent dimensional stability, which allow sound waves to travel through it with little damping. It can be used in many different areas, such as building, furniture, musical instruments, and environmental protection. Being one of the lightest hardwoods and having a low density (about 300 kg/m^3), *Paulownia* is easy to handle and move. The wood is smooth and light in color, with a straight, delicate, and regular grain pattern. Its surface is silky and smooth, with very few knots, and it has a satiny gloss. Its unique properties make it particularly resonant, which is useful when creating musical instruments. Similar to swamp ash, its resonance and low weight make it a popular choice for electric guitar bodies.

Paulownia wood is a robust, lightweight, and quickly growing wood that is well-known for its exceptional insulating qualities and decay resistance. Princess tree, kiri, paulownia, and royal paulownia are the common names. *Paulownia tomentosa* is the scientific name. The species grows in eastern North America and is indigenous to eastern Asia. The tree is 0.6 m to 1.2 m in diameter and 0 to 20 m tall. With a 12% moisture content, the specific gravity is 0.25 to 0.28 and the average dried weight is 280 kg/m^3. The crushing strength is 20.7 MPa, the elastic modulus is 4.38 GPa, the modulus of rupture is 37.8 MPa, and the Janka hardness is 1,330 N. When measured longitudinally, or parallel to the grain, paulownia wood's elastic modulus, or modulus of elasticity (MOE), is significantly higher than when tested transversely. Although specific values vary by species and growing conditions, longitudinal MOE is often between 3800 and over 5000 MPa, demonstrating its anisotropic nature where strength is concentrated along the wood fibers. For example, paulownia clone *in vitro* 112 has an MOE of 3800 MPa. Transverse MOE data would still be much lower than longitudinal values, although being less common in search results. The volumetric, tangential, and radial shrinkages are 6.4%, 3.9%, and 2.4%, respectively. The ratio of tangential to radial (T/R) is 1.6.

EXPERIMENTAL

The Suzuki taishōgoto was selected for this study for two reasons: (1) it represents a widely available and standardized modern version of the instrument, ensuring that the findings are replicable and comparable across contexts; and (2) it features consistent construction and tuning (all strings set to G by default), which reduces variability and makes it suitable for controlled acoustic evaluation. By choosing a commercial instrument model, the authors ensured that the results are not limited to a unique or handcrafted specimen but instead reflect the characteristics of an instrument that can be commonly accessed by musicians and researchers. It helps the community's cultural activities get back on track. In addition, it may facilitate innovation/evolution of taishogoto in the future in the tuning system. It also helps the sustainability of the community to keep the cultural playing and studying on taishogoto.

Figure 2 shows a Suzuki soprano taishōgoto used in this study. The taishōgoto have the notes ranging from open string G3 to A5# (a total of 27 frets). All the open strings of this instrument, by default, are G. Basso is tuned to lower G, tenor (1 octave up the basso), and soprano (2 octave up the basso). With a G tuning of a 5-strings instrument, the upper string is G4, then G3 for the octave down, and G2 for the bass string. The string gauges are as follows: The first through third strings are all tuned to the same G with string gauge 0.2 mm. The fourth string is tuned to G one octave lower than the third string with string gauge 0.3 mm. The fifth string is tuned to G one octave lower than the fourth string with string gauge 0.5 mm.

Fig. 2. An acoustic Suzuki soprano taishōgoto

Figure 3 shows the mechanism of contacting and holding the strings. When a key is pressed with the left hand, a metal bar rises to fret the strings at that location, thereby altering their effective length and raising the pitch. This is how taishogoto typewriter keys work as an automatic fretting mechanism. The musician can choose a certain note with this action, which is comparable to a typewriter key, without actually touching the strings with their fingers. The instrument's characteristic sound is produced by the right hand strumming the strings close to the bridge with a pick while the left hand manipulates the keys to make the notes. A metal bar beneath a typewriter-like key slides higher when the player presses it with their left hand. By pressing the string up against a fret on the fretboard, this metal bar reduces the string's vibrating length. A higher musical note is produced by the shorter string vibrating at a higher frequency. The automated fretting system in the keys makes it simple to perform intricate notes and melodies.

Fig. 3. The mechanism of contacting and holding the strings

Regarding environmental controls, all recordings were conducted in an anechoic chamber to eliminate reflections and external acoustic interference, ensuring that only the instrument's direct sound was captured. A fixed microphone placement (20 cm, omnidirectional polar pattern) was maintained throughout to guarantee consistency in sound capture. Furthermore, the instrument was played in a conventional seated position by a skilled player to replicate realistic performance conditions, while multiple rehearsals were carried out to standardize plucking technique and force. Each trial was repeated under identical conditions, and the resulting waveforms were averaged to reduce noise and variability. Together, these steps ensured that both environmental and performance factors were tightly controlled, thereby enhancing the validity and reliability of the acoustic measurements. The sound signals were captured in real time using a PicoScope 3000 series oscilloscope and accompanying data recorder (Pico Technology, Eaton Socon, UK). The PicoScope software enabled waveform viewing, Fast Fourier Transform (FFT) analysis, spectrum visualization, and voltage-based triggering. The apparatus used in the experimental setup is provided in Fig. 4.

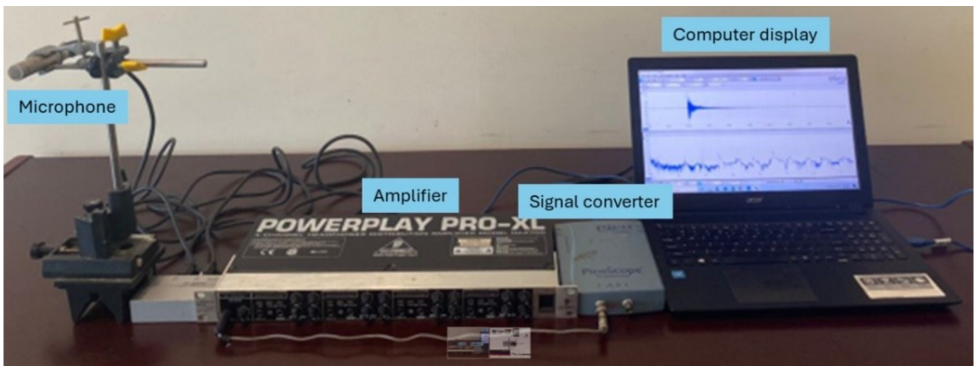

Fig. 4. The apparatus used in the experimental setup

To prevent distortion or bias, the taishōgoto was recorded under identical conditions, including fixed microphone position and orientation. The signal was amplified using a Behringer Powerplay Pro XL amplifier (Zhongshan, Guangdong, China) before being processed by the PicoScope. The resulting sound spectra were analyzed in Adobe Audition, where FFT analysis was used to extract dominant frequencies and evaluate tonal characteristics. The Fourier Transform technique enabled identification of fundamentals, harmonics, and subharmonics in the recorded waveforms. Sound data from the taishōgoto were collected in multiple trials. Each iteration was recorded under the same conditions, and the resulting waveforms were averaged to reduce variability and noise. This approach ensured a robust and meaningful acoustic comparison. By employing controlled plucking, consistent recording parameters, and multiple rounds of measurement with averaged data, the methodology ensures a clear, accurate, and scientifically valid comparison of the acoustic performance of the taishōgoto.

RESULTS AND DISCUSSION

Figure 5 shows the open string G3 and G4 (from both the tenor (G3) and soprano (G4)) strings with partials 112, 195, 266, 387, 499, 584, 667, 775, 886, 975, 1057, 1170, 1284, and 1441. Figure 6 shows the fret 3, A3# (233.08Hz), and A4# (466.16Hz) with partials 232, 347, 464 and 232, 463, 695, 926, 1168, 1369. The partials from Figs. 5 and 6 are displayed in Table 1. In Table 1, partials frequency (f_n) for the open string and fret 3 are displayed with the harmonic number (f_n/f_0), where f_0 is the fundamental frequency.

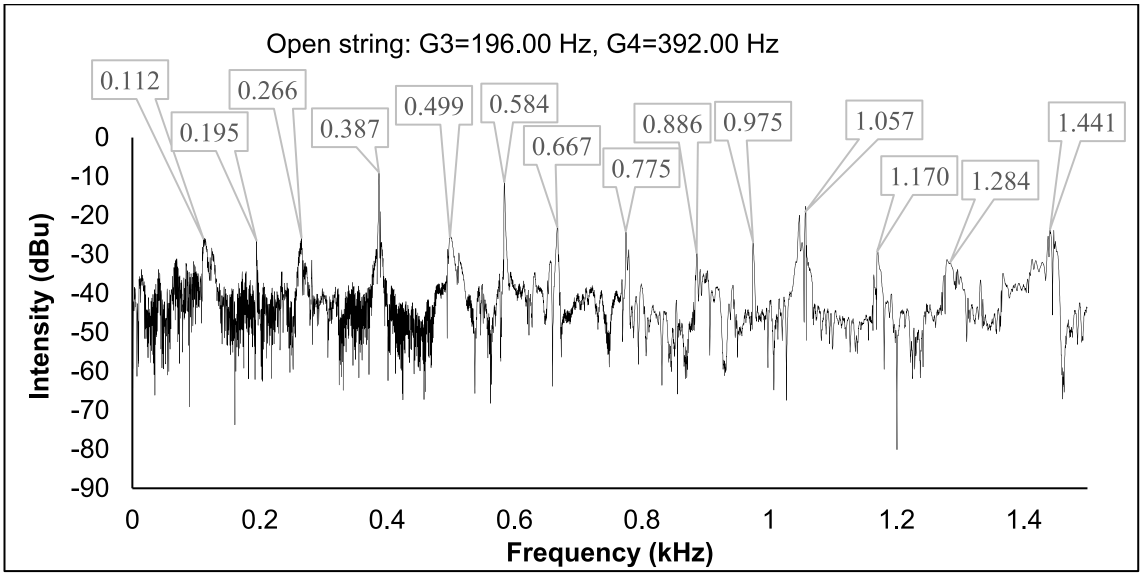

Fig. 5. The open string, (G3 (196.00Hz) and G4 (392.00Hz)) with partials 112, 195, 266, 387,499, 584, 667, 775, 886, 975, 1057, 1170, 1284, and 1441

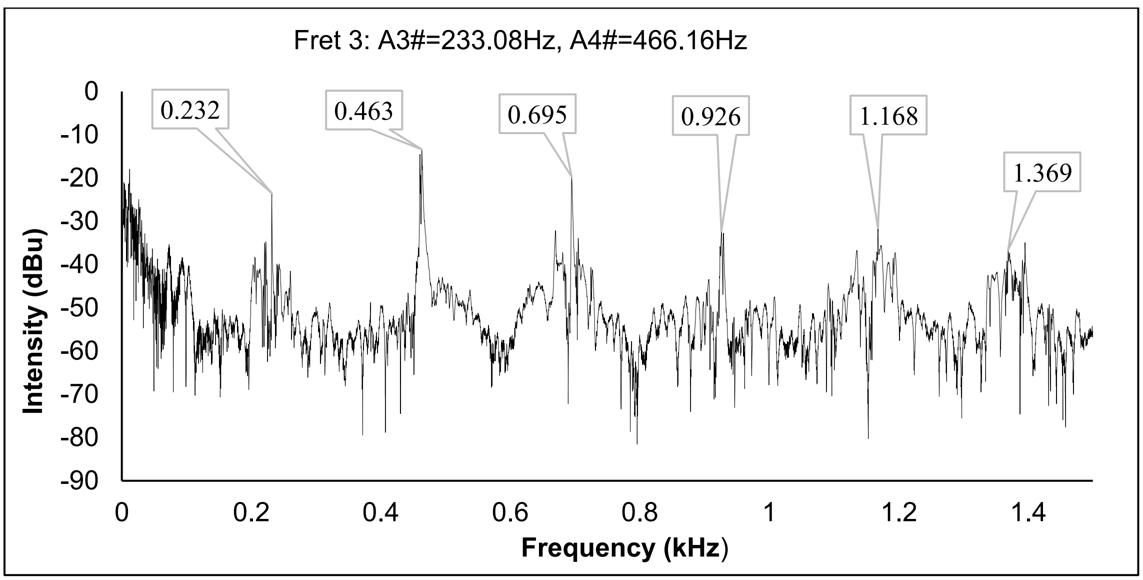

Fig. 6. The fret 3, (A3# (233.08Hz) and A4# (466.16Hz)) with partials 232, 463, 695, 926, 1168, and 1369

From Table 1, the partials frequency *versus* the partials number are plotted in Figs. 7 and 8 for open string and fret 3, respectively. From Fig. 7, the partials frequency *versus* the partials number for open string is given by the equation y=101x+76.88. Although the fundamental frequency was 195 Hz (G3=196.00 Hz), the gradient indicates the value of 101x (*i.e.*, G2=97.99 Hz, not G3). From Fig. 8, the partials frequency *versus* the partials for the fret 3 is given by the equation y=230x+5.73. The fundamental frequency was 232 Hz (A3#=233.08 Hz), and the gradient indicates the value of 230 Hz, which was almost similar to the fundamental frequency (*i.e.*, A3#=233.08 Hz).

Table 1. The Partials Frequency and Harmonic Number (f_n/f_0) for Open Strings (G3 (196.00 Hz) and G4 (392.00 Hz)) with Partials 195, 266, 387,499, 584, 667, 775, 886, 975,1057, 1170, 1284, and 1441 Hz and for the Fret 3 (A3# (233.08 Hz) and A4# (466.16 Hz)) with Partials 232, 463, 695, 926, 1168, and 1369 Hz

Open String (G3 and G4)		Fret 3 (A3# and A4#)	
Partials frequency	Harmonic number (fn/f0)	Partials frequency	Harmonic number (fn/f0)
195 (G3)	1	232 (A3#)	1
266	1.36	463 (A4#)	1.99
387 (G4)	1.98	695	2.99
499	2.55	926	3.99
584	2.99	1168	5.03
667	3.42	1369	5.90
775	3.97	-	-
886	4.54	-	-
975	5	-	-
1057	5.42	-	-
1170	6	-	-
1284	6.58	-	-
1441	7.38	-	-

From Table 1, Figs. 9 and 10 are plotted for harmonicity (f_n/f_0) *versus* the partials number for the open string and fret 3. The gradient 0.51 (from y=0.51x+0.39 in Fig. 9) indicates that the partials consisted of both the harmonic 1, 2, 3, 4…. and in-harmonics (~1.5, ~2,5, ~3.5, ~4.5….).The gradient 0.98 (from y=0.98x+0.02 in Fig. 10) indicates that the partials consisted of the harmonics 1, 2, 3, 4…. only. Using the same procedure partials frequency *versus* partials number and the harmonicity *versus* partials number for open string and fret 1 to fret 27 are generated in Table 2.

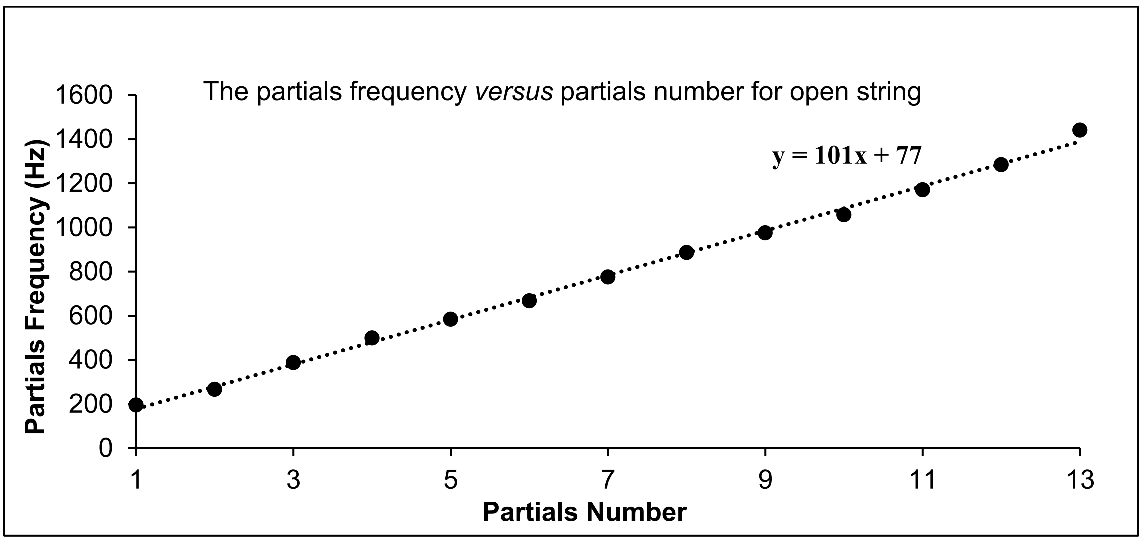

Fig. 7. The partials frequency *versus* the partials number for open string (no. 1 is the fundamental frequency)

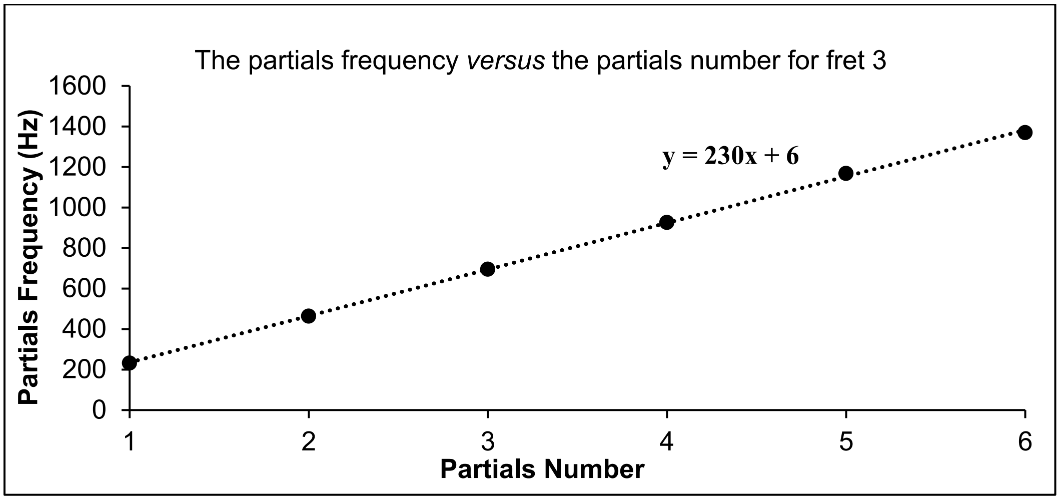

Fig. 8. The partials frequency *versus* the partials number for fret 3 (no. 1 is the fundamental frequency)

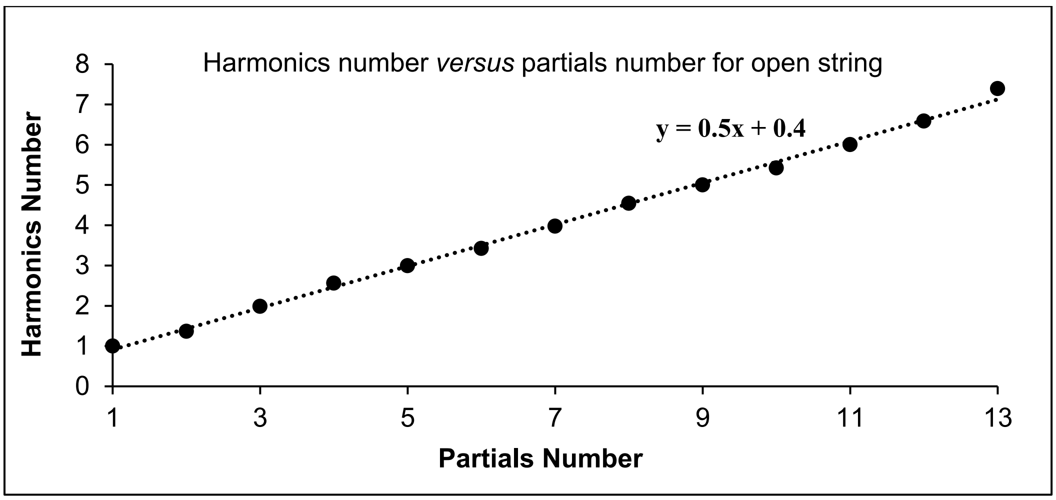

Fig. 9. Harmonic number (f_n/f_0) *versus* the partial number for open string (no. 1 is the fundamental frequency)

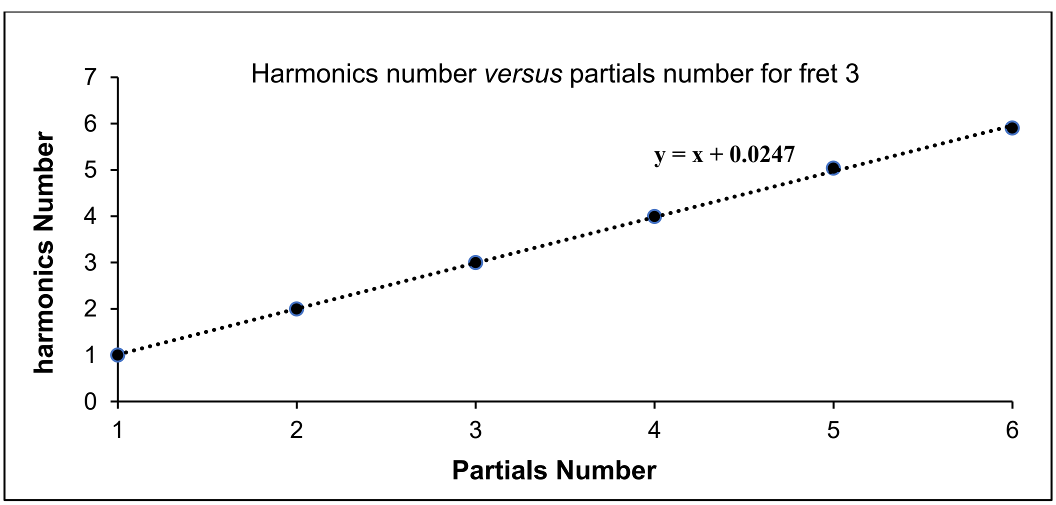

Fig. 10. Harmonic number (f_n/f_0) *versus* the partial number for fret 3 (no. 1 is the fundamental frequency)

Table 2. The Equations for Partials Frequency *versus* Partials Number and the Equations for Harmonicity *versus* Partials Number for Open String and Fret 1 to Fret 27

Fret number (f_0 Hz)	Partials frequency *vs.* partials number	Harmonicity *vs.* partial number	Type of partials
Open string (196~G3)	yopen=101x+77	yopen=0.5x+0.4	Harmonics and in-harmonics
1 (207~G3#)	y1=104x+101	Y1=0.5x+0.5	Harmonics and in-harmonics
2 (219~A3)	y2=97x+166	Y2= 0.4x+0.8	Harmonics and in-harmonics
3 (232~A3#)	y3=230x+6	**Y3=x**	**Only harmonics 1, 2, 3…**
4 (246~B3)	y4=252x-3	**Y4=1x**	**Only harmonics 1, 2, 3…**
5 (260~C4)	y5=130x+ 128	Y5=0.5x+0.5	Harmonics and in-harmonics
6 (276~C4#)	y6=215x+109	Y6=0.8x+0.4	Harmonics and in-harmonics
7 (292~D4)	y7=183x+63	Y7=0.6x+0.2	Harmonics and in-harmonics
8 (309~D4#)	y8=125x+229	Y8=0.4x+0.7	Harmonics and in-harmonics
9 (327~E4)	y9= 332x - 3	**Y9=1x**	**Only harmonics 1, 2, 3**
10 (346~F4)	y10=150x+143	Y10=0.4x+0.4	Harmonics and in-harmonics
11 (368~F4#)	y11=368x+3	**Y11=x**	**Only harmonics 1, 2, 3**
12 (388~G4)	y12=132x+252	Y12=0.3x+0.6	Harmonics and in-harmonics
13 (412~G4#)	y13=131x+258	Y13=0.3x+0.6	Harmonics and in-harmonics
14 (437~A4)	y14=157x+248	Y14=0.4x+0.6	Harmonics and in-harmonics
15 (463~A4#)	y15=194x+90	Y15=x+0.5	Harmonics and in-harmonics
16 (498~B4)	y16=498x-10	**Y16=1x**	**Only harmonics 1, 2, 3**
17 (522 (C5)	y17=213x+380	Y17=0.4x+0.7	Harmonics and in-harmonics
18 (552 (C5#)	y18=224x 232	Y18=0.4x+0.4	Harmonics and in-harmonics
19 (577~D5)	y19=242x+260	Y19=0.5x+0.5	Harmonics and in-harmonics
20 (623~D5#)	y20=190x+66	Y20=0.7x+0.3	Harmonics and in-harmonics
21 (657~E5)	y21=305x-237	Y21=2.9x-2.3	Harmonics and in-harmonics
22 (689~(F5)	y22=239x-47	Y22=1.6x-0.3	Harmonics and in-harmonics
23 (734~F5#)	y23=367x+261	Y23=0.5x+0.4	Harmonics and in-harmonics
24 (786~G5)	y24=535x-229	Y24=1.6x-0.7	Harmonics and in-harmonics
25 (836~G5#)	y25= 475x + 361	Y25=0.6x+0.4	Harmonics and in-harmonics
26 (877~A5)	y26=304x+282	Y26=0.5x+0.5	Harmonics and in-harmonics
27 (1106~A5#)	y27=328x+447	Y27=0.4x+0.6	Harmonics and in-harmonics

If the partials are all harmonics, then the gradient of the partials frequency *versus* partials number are similar to the fundamental frequency, as shown in frets 3 and 4 with the gradient of the harmonicity *versus* partials number equal to unity.

-The open string (G3=196.00) showed a gradient 101 similar to G2 (97.99).
-The fret 1 (G3#=207.65) showed a gradient 104 similar to G2# (103.88).
-The fret 2 (A3=220.00) showed a gradient 97 similar to A2 (110.00).
-The fret 3 (A3#=233.08) showed a gradient 230 similar to A3# (233.08).
-The fret 4 (B3=246.94) showed a gradient 252 similar to B3 (246.94).

Although the fundamental frequencies obtained were in accordance with the pitch being tuned, the gradient of the equation for:

-The fret 5 was 130 (*i.e.*, not C4=261.63).
-The fret 6 was 215 (not C4#=277.18).
-The fret 7 was 183 (not D4=293.67).
-The fret 8 was 125 (not D4#=311.13).
-The fret 9 was 332 (*i.e.*, ~E4=329.63).

The gradient of the partials frequency *versus* partials number were similar to the fundamental frequency of fret 9 with the gradient of the harmonicity *versus* partials number equal to unity. The deviation in the gradient from the tuned pitch was caused by the number of in-harmonic partials in the spectrum. Although the fundamental for:

-The fret 10 was 346 (~F4=349 Hz), the gradient was only 150.
-The fret 11 was 368 (~F4#=369 Hz), the gradient was 368 (~F4#=369Hz).
-The fret 12 was 388 (~G4=392 Hz), the gradient was only 132.
-The fret 13 was 412 (~G4#=415.30 Hz), the gradient was only 131.
-The fret 14 was 437 (~A4=440), the gradient was only 157.
-The fret 15 was 463 (~A4#=466), the gradient was only 194.
-The fret 16 was 498 (~B4=493), the gradient was exactly 498 (~B4=493).
-The fret 17 was 522 (~C5=523), the gradient was only 213.
-The fret 18 was 552 (~C5#=554), the gradient was only 224 (~C4#=277.17)
-The fret 19 was 577 (~D5=587), the gradient was only 242 (~D4=293.67).
-The fret 20 was 623 (~D5#=622), the gradient was only 190.
-The fret 21 was 657 (~E5=659), the gradient was only 305. (~E4=329.63).
-The fret 22 was 689 (~F5=698), the gradient was only 239.
-The fret 23 was 734 (~F5#=739), the gradient was only 367. (~F4#=369.99).
The fret 24 was 786 (~G5=783), the gradient was only 535.
The fret 25 was 836 (~G5#=830), the gradient was only 475.
The fret 26 was 877 (~A5=830), the gradient was only 304.
The fret 27 was 1106 (~A5#=923), the gradient was only 328.

The gradient of the partials frequency *versus* partials number were similar to the fundamental frequency for frets 11 and 16 with the gradient of the harmonicity *versus* partials number equal to unity. The harmonic series exhibited a fundamental relationship with timbre, which is the perceived quality or character of a musical sound. For frets 3, 4, 9, 11, and 16 the gradient of the harmonicity *versus* partials number was equal to unity. For these 5 frets, the gradient of the partials frequency *versus* partials number were similar to the fundamental frequency. Only these 5 frets displayed harmonic overtones. The overtones or other frequencies that were in-harmonic with the fundamental *i.e.*, not in sequence of frequencies (not an integer multiples of the fundamental frequency) yielded the gradient of the harmonicity *versus* partials number not equal to unity.

Each fret exhibited a distinct timbre that was determined by the presence, absence, and relative intensity of certain overtones in the harmonic series. A fret does more than simply vibrate the string at the fundamental frequency when it makes a note. The fret produces overtones or harmonics when the string vibrates at multiples of that frequency. What makes the string sound different is the particular pattern of these overtones. The string physically produces vibrations with a specific frequency. The timbre of the string is determined by the frequencies that it produces because each string vibrates somewhat differently. The fret generates a set of frequencies that are both harmonic and in-harmonic. Every fret has a unique set of overtones that combine to produce the instrument's distinctive sound. The best way to characterize this sound and to distinguish between the various frets is timbre. Timbre is distinct from pitch, rhythm, and volume and can be described in a variety of ways. Brightness or darkness is one of the most widely used terms to define timbre in relation to an instrument's frequency range. The timbre is perceived as darker when there are more overtones. The timbre of the musical instrument is considered as having a brighter tone when there are fewer audible overtones.

Because of its distinctive tone and structure, the taishōgoto can be used in a variety of musical genres. Its simplicity and capacity to accompany singing or other instruments have made it a traditional part of Japanese folk and popular music. Its strung character has appealed to guitarists and koto players, while its keyboard-like interface made it accessible to those who were already familiar with the piano. With the introduction of electric and sampled variants, the taishōgoto is used in electronic, ambient, and experimental music today. Its plucked tones, manipulated noises, and mechanical clicks are used by producers and composers for multimedia installations, video game soundtracks, and movie compositions. The instrument is a favorite among sound designers looking to strike a balance between natural and artificial textures because of its capacity to combine classic timbres with contemporary effects. Taishōgoto-based virtual instruments, such as those made for Kontakt, offer carefully captured articulations that let musicians incorporate the instrument's sound into digital compositions. These libraries frequently contain pitches that have been processed using antique equipment, providing a range of sounds from clear, melodic tones to distorted, lo-fi, and broken textures. Because of its adaptability, taishōgoto is still important in both conventional and avant-garde musical contexts (Organology 2025)

Taishōgoto combines the principles of a string zither with a keyboard mechanism. It became well-liked since it was simple to play and made nice melodies. Folk music, education, and therapeutic purposes all make use of the Taishōgoto. It is frequently used to teach melody and harmony because of its straightforward construction. It has also been used by contemporary performers in pop and experimental music genres. The body amplifies the sound by acting as a resonator. For durability, some contemporary versions could use synthetic materials. Clear tonal quality and lightweight design are guaranteed by the combination. The most distinctive aspects of the taishogoto's timbre are its overtone structure. Its structure gives it this quality where the metal bars press the strings against the frets, creating a brilliant, metallic resonance that mutes some partials and accentuates higher ones. This type of sound profile is consistent with the larger aesthetics of Japanese music, where timbre of color, brightness, and resonance are valued more highly than harmonic richness in instruments such as the shamisen. Hence, it shows also the partials-only resonance as a result of its hybrid design as well as a characteristic that corresponds with cultural sound. As a result, the instrument's unique overtone emphasis might be regarded as a memorable acoustic indicator of its uniqueness within in Japan's musical history.

In music production, the electric taishōgoto, especially those made in the 1990s, has grown in popularity as a source of distinctive sounds. Its sampled versions, which have been processed using ancient equipment, capture the peculiarities and flaws that give the instrument its unique character in addition to the melodic notes. This fusion of innovation and tradition guarantees that the taishōgoto will continue to inspire both audiences and artists. With the introduction of electric and sampled variants, the taishōgoto is used in electronic, ambient, and experimental music today. This electric version for bigger amplitude is amplified when played in a large public. Figure 11 shows the electric version of the taishōgoto.

Fig. 11. The electric version of the taishōgoto

CONCLUSIONS

In Japanese musical culture, the taishogoto is a unique invention that combines originality with useful accessibility.

1. Its unique design, which combines a strung zither body with a keyboard mechanism akin to a typewriter, makes it easy to achieve precise pitch while generating a rich, bright timbre full of overtones.
2. Because of its accessibility, it was widely used as a teaching and community tool, especially during the Taishō era, when it represented both cultural fusion and modernization.
3. But there are drawbacks to the tool as well. In comparison to the shamisen, it has a more limited dynamic range and expressive potential, a fixed fret system that limits tonal flexibility, and a moderate natural sound projection that frequently requires amplification in ensemble setting.
4. The taishogoto regardless finds practical applications in spite of these limitations. It has been evolved into a variety of genres, such as jazz, world, and folk music, and it continues to be of interest to experimental composers who are experimenting with its unique tonal characteristics.
5. It is also a useful tool for musical education and leisure, particularly for novice and mature audiences. The taishogoto thus has a special place between usefulness and artistry, history and modernity, and innovation and limitation.

ACKNOWLEDGMENTS

The authors would like to acknowledge Universiti Putra Malaysia Bintulu Campus and Universiti Malaysia Sarawak (UNIMAS) for the technical and financial support.

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Article submitted: June 13, 2025; Peer review completed: August 30, 2025; Revised version received: September 9, 2025; Accepted: November 13, 2025; Published: December 3, 2025.

DOI: 10.15376/biores.21.1.606-620