# Online Tablature:

## An Analysis of Popular Online Tablature Websites

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Date: July 10, 2020

# Abstract

Many guitar education websites exist with varying degrees of tablature accuracy, causing many beginner guitarists to struggle identifying useful content. We analyzed the efficacy of popular tablature websites as educational tools by identifying these websites' features. We surveyed beginner and intermediate guitarists to identify popular tablature websites, website features, and tablature style. We found the best method for beginner guitarists learning new songs to be through a guitar teacher, although YouTube can serve as a substitute.

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# Executive Summary

A variety of guitar education websites exist today with the purpose of teaching guitarists at all skill levels new songs using tablature, each with strengths and flaws. Shortcomings of these websites may include poor organization, limited features, and inconsistent tablature accuracy, any of which are detrimental to the educational potential of these websites. Identifying the shortcomings and analyzing the overall effectiveness of guitar education websites provides a useful guide for guitarists on online tablature.

We analyzed the efficacy of popular tablature websites as educational tools and identified these websites' features and shortcomings. Our research was guided by the following objectives:

1. We identified the most popular tablature websites and why guitarists preferred them.

2. We assessed each website's features, determining which were popular among guitarists, as well as what was missing.

3. We researched effective strategies for learning guitar music and compared them to the strategies employed by popular tablature websites.

With the completion of our goal and objectives, we identified popular sources of guitar tablature on the internet and the tablature styles most helpful in teaching beginner guitarists new songs. We concluded that YouTube, Ultimate Guitar, and Songsterr are the most popular websites for tablature and they provide the best teaching experience for beginner guitarists. Ultimate Guitar and Songsterr have more educational features than other tablature websites, and specific YouTube channels provide tablature with consistent quality. This project also serves as a guide for future IQP groups, as it documents both our group's failures throughout the IQP process, and what we learned from our experiences.

To identify the most popular tablature websites, we sent two similar surveys to two different music communities, receiving a total of 26 responses. To gain further insight into the efficacy of these websites, we also interviewed Professor V.J. Manzo, a musician and educator with 25 years of professional guitar experience. We sent the first survey to the WPI Marching and Pep Band and the WPI Concert Band members, and the second survey to the subreddit r/GuitarLessons. The WPI Marching, Pep, and Concert bands consist of 315

college musicians with varying levels of experience, with many having guitar experience. The subreddit r/GuitarLessons consists of 135,000 members with varying levels of guitar experience. It was impossible to determine the number of active members in subreddit r/GuitarLessons. We chose these guitar communities because most participants have musical backgrounds and experience reading guitar tablature when learning new songs. The surveys focused on what tablature websites survey participants used and why, which types of tablature participants used when learning songs, and what features in online tablature websites they found the most useful, which allowed us to compare websites based on the features they offer and the features that survey participants prefer to use.

We researched the websites Ultimate Guitar, Songsterr, YouTube, GuitareTab, Chordie, GuitarTabs.cc, and tabs4Acoustic. We selected these websites based on their popularity among survey participants. We identified the features of each website based on three identical sample songs that were on each website, and ranked each website based on a variety of metrics, such as their inclusion of features, the websites' overall organization and tablature library size, and the websites' popularity among survey participants. We based our metrics on features that survey participants indicated as important in tablature websites. We rated website features in four different ways, where lower scores were indicative of a better experience as some of our scoring methods involved ranking website features from one to seven. The first method pertained to whether websites had a given feature, where websites obtained a zero for having a feature, one for varying support, and two for not supporting the feature at all. The second scoring method ranked the websites, assigning a relative score from one to seven to each website. The third method scored websites on their popularity among survey respondents, and the last scoring method compared the amount of advertising (ads) on the websites. The numerical representation of the data removed biases, regardless of if they were intentional, allowing us to identify the best tablature websites.

The largest number of survey participants reported using Ultimate Guitar in both music communities, as 14 of the 18 respondents to the first survey and five of the eight respondents to the second identified using Ultimate Guitar. All respondents stated that slowing the tempo of fast sections is beneficial to learning how to

play, while learning by ear was much less popular with just 1 respondent. Between the two surveys, 22 of the 26 respondents preferred online tablature, with only four preferring printed tablatures or other media.

Based on our findings from the surveys, interview, and our ranking of tablature websites we recommend that beginner guitarists attempt learning new skills from guitar teachers or skilled guitarists. Tablature websites are best for repeatedly practicing new songs to add to a guitarist's repertoire. Guitar teachers often have years of experience transcribing the audio of guitar songs, and therefore are the most likely to know the correct way to play a piece. However, if the option of learning from a teacher is not available, we advise beginner guitarists to use YouTube for tablature, once they find a channel with consistently accurate guitar tabs. YouTube allows users to receive tablature with consistent, and therefore trustworthy, accuracy from a single source. Guitarists can also cross check different YouTube videos of the same song, if available, to ensure the accuracy of the tablature. Guitar tablature websites such as Ultimate Guitar and Songsterr are Wiki style, where anyone can add tablature to the database. The abundance of guitar tablature makes it difficult for moderators to identify and resolve tab mistakes on all posted songs. Posting tablature to these websites requires no credentials; users may be unqualified and post incorrect tablature. Skilled guitarists can easily identify and fix errors in tablature, but beginner guitarists often cannot, which can impede their learning. Using incorrect tablature can lead to poor playing habits in beginner guitarists.

# 1.0 Introduction

Tablature, or "tab," has served as an integral form of music notation for stringed instruments since its creation for the lute in the 16th century (Thompson, 2011). Today, tablature is most frequently used by guitar and bass players seeking to quickly learn new songs due to its logical depiction of guitar fingerings. Tablature is also popular among guitarists who cannot read traditional musical notation, guitar students in particular, as understanding tablature requires little prior knowledge of musical notation (V.J. Manzo, personal communication, June 18, 2020). Guitarists view tablature through many different mediums, such as published books and magazines, although the advent of the internet has led many to view tablature online out of convivence.

The widespread availability of people to create a website and post content online causes variability in the quality of websites and their content, affecting the accuracy of online tablature. Tablature accuracy issues are a concern for new guitarists, who may not be capable of discerning errors in guitar tablature. Additionally, the sheer number of sources available to guitarists makes it difficult to discern high-quality guitar content on the internet. The multitude of tab websites make finding the best tab difficult, especially for new guitarists. Beginner guitarists struggle to identify websites with correct, easy to use tablature.

Currently, there are a myriad of websites that offer tablature to guitarists, with only some containing high-quality tablature. Popular websites such as Ultimate Guitar and Songsterr have their own forms of interactive tablature, which contain features such as automatic scrolling, variable playback speed, and audio overlay. GuitareTab is a website that simply provides PDF images of popular guitar song tabs, and other websites are simply databases of popular songs that link to other websites' tablature. Guitar tablature is also common on streaming websites such as YouTube, which receive massive amounts of web traffic, although the site does not solely feature tablature content.

While a variety of digital educational websites for teaching guitarists new songs exist, each have shortcomings beginner guitarists should know.  Guitar education websites may lack organization, making navigation difficult, contain limited features to assist beginner guitarists with learning new songs, or hold

inaccurate tablature. Each of these shortcomings are detrimental to the educational potential of these websites. To the best of our knowledge, no formal analysis of the shortcomings of tablature websites previously existed aside from casual blog posts and website recommendations. We analyzed the efficacy of popular tablature websites as educational tools and identified these websites' features and shortcomings.

In developing a guide of the features and shortcomings of several popular digital educational guitar websites, we had the following objectives:

1. We identified the most popular tablature websites and why guitarists preferred them.
2. We assessed each website's features, determining which were popular among guitarists, as well as what was missing.
3. We researched effective strategies for learning guitar music and compared them to the strategies employed by popular tablature websites.

With the completion of our goal and objectives, we aim to provide a resource to beginner guitarists on sources of guitar tablature on the internet and identify which are the most helpful in teaching new songs. This project also serves as a guide for all IQP groups, as it documents both our group's failures throughout the IQP process and what we learned from our experience.

# 2.0 Background

Tablature has become increasingly accessible to guitar players through the internet. Guitar players can view guitar tablature from nearly any device with an internet connection and web browser. Since online tablature is easy to access and many websites are open for use without cost, beginner guitarists gravitate towards online tab websites to learn popular guitar music. To outline online tablature's different forms and websites, we first discuss essentials of the guitar to understand different types of tablature. We then examine how to read traditional music notation and how different types of guitar tablature evolved from traditional music notation. Next, we explain the forms of tablature that are common for players to use. Lastly, we identify popular strategies for learning guitar music, essential in evaluating educational tools in tablature websites.

## 2.1 The Guitar

Knowing the components of the guitar is essential to learn to read tablature because the features and symbols in tablature refer to the different parts of the guitar. Some components of the guitar, such as strings and frets, are referenced in tablature to depict correct pitches, chords, and notes. The two most common varieties of the modern-day guitar are the electric and the acoustic, with both having parts that are essential to their unique sound. Starting from the top of the guitar, there is the head that is the base for the tuning keys as referenced in Figure 1 (Hoffman, 2018). On both types of guitar, the tuning keys are essential for determining half step and whole step tuning. By slightly turning the tuning keys, the lengths of the strings can be shortened for a sharper (higher pitched) sound or lengthened for a flatter (lower pitched) sound. The closest part to the head is called the nut (Hoffman, 2018). The nut is located at one end of the vibrating string and is followed by frets which are placed at varying distances down the neck of the guitar. The nut is referenced as the $0_{th}$ fret while other frets below the nut are referenced in descending order from one through 20. The nut and frets are referenced in types of tablature because the players' fingers are placed on top of the strings next to a specific fret. The strings of the guitar are placed above the neck and the frets. The common guitar contains six strings. Starting from the thinnest string, the strings are called string 1, string 2, continuing up until string 6. Strings 1 and 2 are called "plain strings" and are bare steel strings (unwound). Strings 3 through 6 are wound with metal. When holding a

guitar, string 6 is the topmost string. Moving from top to bottom (from thickest to thinnest) results in increasingly higher pitches. The next closest structure is the sound hole shown in the acoustic guitar (see: Figure 1) (Hoffman, 2018). In acoustic guitars, the sound resonates through the body and out of the sound hole to produce sound. Each sound depends on these parts of the acoustic guitar and can be altered to produce custom pitches (Hoffman, 2018).
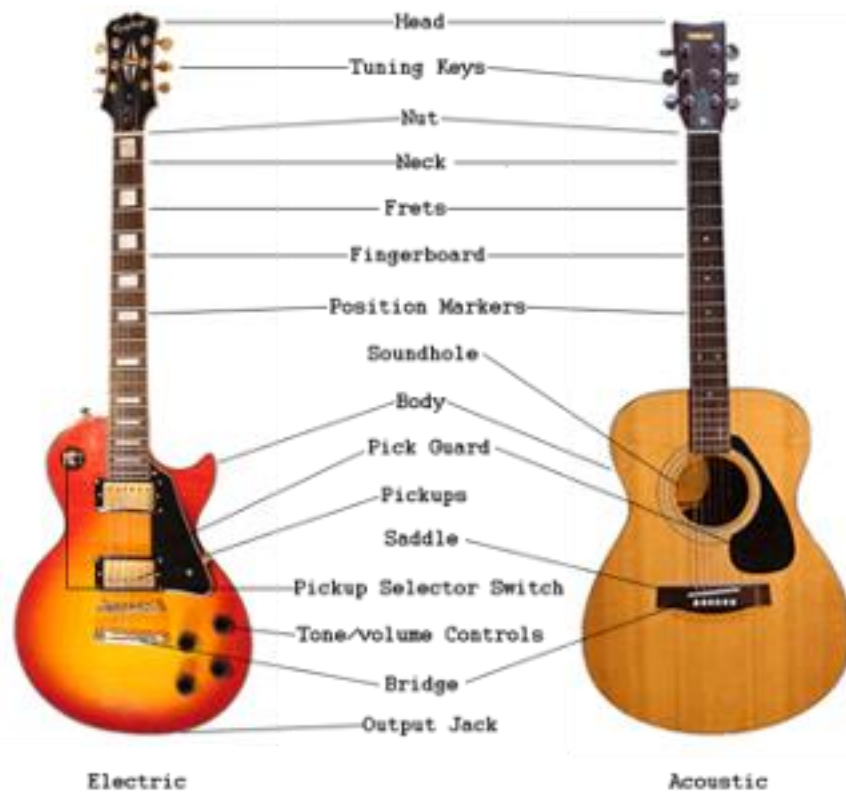


*Figure 1: Diagram of electric and acoustic guitars with labels (Hoffman, 2018)*

The differences between electric and acoustic guitar are in the specific parts of the body. The electric guitar includes body parts to connect and play sound through an amplifier. These parts include a pickup selector switch, tone/volume controls, and an output jack (Hoffman, 2018). The addition of an amplifier allows for louder sounds (Hoffman, 2018). The bridge acts as a spacer for the strings and aids in sound transmission for both types of guitar.

## 2.2 Guitar Music Notation in the Types of Tablature

Music notation evolved from the 13th century to well into the 15th century, transforming into the basis of modern musical notation. Popularized around 1260-1280, the Franconian method of notation improved upon previous notation methods by giving individual notes length values, rather than values based on context (Strayer, 2013). The Ars Nova, or "New Art" period of the 14th century saw the introduction of individual symbols representative of different note lengths, and further improved on the Franconian method (Strayer, 2013). This basic notation gradually increased in detail over time, creating the modern musical language. As it is today, musical notation consists of a series of notes on a staff. The staff consists of five lines and four spaces that represent note pitch, and different symbols on the staff indicate the length of a note. Additionally, the staff features a symbol at the beginning of the first line of music, a clef, which indicates the relative position of all notes on the staff, as well as a time signature, which indicates both the number of beats in a measure, and the type of note (quarter note, half note, etc.) that gets a beat (Gehrkens, 2006). Music notation, while complicated and sometimes time consuming to learn, addresses many aspects of musicality.

While tablature and traditional music notation have similarities, they are different in many ways too. Tablature is a general term that relates to the representation of music using symbols, numbers, or diagrams, as opposed to the conventional staff notation (Thompson, 2011). String instrument players often utilize tablature, as it simply indicates the string and fret position of a given note. The earliest forms of tablature are the Italian and French forms, which date back to the 16th century and were designed for the lute (Thompson, 2011). These old forms of tablature are like what is used today, containing information on string name, fret, and even rhythms. Today, tablature often represents notes on a guitar or bass guitar, as they are common fretted instruments. The music below is an example of one type of tablature combined with traditional notation (see: Figure 2).



*Figure 2: Traditional notation -top- and one form of tablature notation -bottom- (MacFarlane, 2016)*

Tablature is particularly useful in representing different notes to guitar and bass players who do not read traditional sheet music, as it only requires a knowledge of string and fret numbers. However, some forms of tablature provide little rhythmic indication, and therefore rely on the player's prior knowledge of a song, another form of notation, or relative spacings between notes. Despite online text-based tablature's lack of rhythmic indication, it can be a useful tool for learning guitar and bass.

The main purpose of tablature is notating specific finger positions and note pitches on an instrument. Tablature differs from traditional notation, which indicates the pitch of a note, as opposed to where on the instrument a note is played. Tuning refers to the whole and half steps between notes shown on the staff. The standard tuning form follows a tablature staff of six lines for six strings, and a number system that corelates to fret number (see: Figure 3).
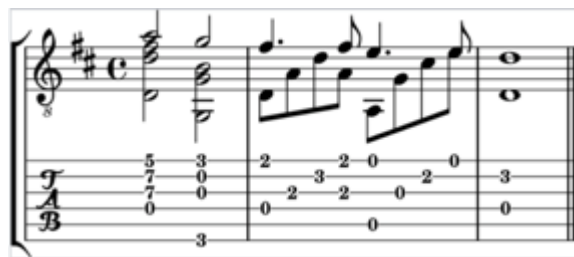


*Figure 3: Standard notation in the top staff and standard tablature on the bottom staff (Guitar, 2009).*

A standard six string guitar has strings $E_2$ $A_2$ $D_3$ $G_3$ $B_3$ $E_4$ ascending in perfect fourths intervals, with an exception between G and B, which is a major third. In tablature, horizontal lines represent the strings, with the top line representing the thinnest string and the bottom line being the thickest string, while the numbers on the string indicate which fret to place the user's finger next to. For example, a "5" on the top line indicates that a finger goes on the $5_{th}$ fret on the thinnest string, $E_4$. A "0" on the line means the string is open, with no finger on a fret while playing the note. In addition, numbers placed vertically next to each other, depict notes that played simultaneously such as the 5,7,7,0 notation in the first measure of Figure 3 (Guitar, 2009). This method of finger fret placement is straightforward and makes reading specific notes and chords easy. The small numbers

save space on the page, while still including finger placement on all six strings and every fret. To express the rhythm shown in standard notation, the bar and stem of the notes can be placed under the number which acts as the head of the note on the tab staff.

However, there are some shortcomings to tablature, specifically with finger placement. Many instruments, including the guitar, have alternate fingerings for notes, allowing the guitarist to play identical pitches on a different string and fret. This alternate fingering is particularly helpful for notes in a sequence, since some notes may have easier fingerings that make transitioning between notes quicker. Players may not want to play difficult passages transitioning from using all fingers to no fingers quickly, or placements where their fingers are stretched uncomfortably. Tablature does not indicate specific fingerings, and the player decides finger placement on specific frets. For inexperienced guitar players, deciding what fingerings to use can be quite intimidating, since the most efficient fingerings may still be unknown to beginner readers. This issue leads to problems with stretching fingers too far up or down the neck of the guitar, making playing notes in sequence more difficult. For advanced guitarists, the freedom of finger placement is beneficial, since these players better understand their training and know the easiest way to transition between notes. Also, advanced readers have the option to add pitch bends, which are indicated by lines linking two fret numbers together.

One tablature method that addresses the issue of finger placement is chord box tablature. The chord box method is a diagram of how to play a chord/note on a guitar by representing strings and frets in diagram form. The diagram focuses on finger placement by simulating the neck of a guitar from the bottom to the top on the neck (see Figure 4), but some versions do not include numbers to indicate finger placement.
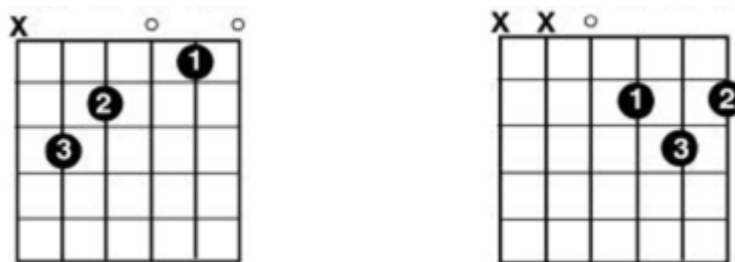


*Figure 4: Two chords (C and D) in chord box tablature notation (Guitar, 2009).*

The chord box structure is a diagram of the entire guitar neck and depicts chord fingerings for beginner players. The tablature reads from the thickest string on the left vertical line to the thinnest string on the right

vertical line. The horizontal lines represent each fret, corresponding to the fret positions on the standard guitar from top to bottom. The line at the very top of the box is there to represent the nut. The crosses shown above the nut indicate the strings that are not strummed or picked and may need to be muted. The open circles above the neck indicate to play the string open with no fingers on frets. Lastly, the dots on the vertical lines indicate where to place fingers. The numbers marking the dots represent the "fretting fingers", and can be a 1, 2, 3, or 4. The index finger is number 1, the middle finger is number 2, the ring finger is number 3, and the little finger is number 4 (Guitar, 2009).

There are differences in what the box represents in this type of tablature. The first difference is that either two horizontal lines close together or one solid horizontal line at the top of the box represent the nut. The second is that some people prefer the diagram flipped horizontally, which matches the position of the neck while playing. Players chose based on their preferences and become accustomed to how chords are depicted in each diagram. One shortcoming of the chord box diagram is that the strings are not labeled, often causing confusion for new guitar players.

Because chord box tablature is large and takes up a lot of space, it is typically used for chords only. However, chord box structure is simplest for teaching basic guitar chords and notes as it is both straightforward and easy to learn. Chord boxes are often placed in sequence on a page, representing scales and chord progressions. However, chord box tablature is not suitable notation for learning entire songs as it inefficiently depicts musical concepts and uses a lot of space. These problems produce inconvenient scrolling online or turning pages in printed copies more frequently than other forms of music notation and tablature.

Tablature and chord box tablature are better suited for paper prints and images, rather than online formatting, as using keyboard symbols rather than solid lines is difficult. Software for adding solid rhythm lines, such as Power Tab Editor, are available. However, not every guitar player has access to Microsoft Windows operating system or knows how to use the software effectively. Therefore, online text-based tablature can be easily typed online or in text boxes (Matthies, 2019). This form of tablature is most like standard tablature but is easier for people to type on a website (see: Figure 5).

```
e|------------------------------------------------------------------|
B|------------------------------------------------------------------|
G|--0----3-----5---------0----3----6--5-------0----3-----5------3----0---|
D|--0----3-----5---------0----3----6--5-------0----3-----5------3----0---|
A|------------------------------------------------------------------|
E|------------------------------------------------------------------|
```
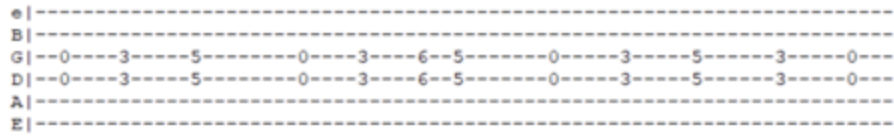
*Figure 5: An example of an online form of tablature (Matthies, 2019).*

This form of tablature represents the strings from thinnest at the top, indicated by note name "e", to thickest at the bottom, indicated by note name "E." As in tablature, the numbers indicate the fret and provide an easy transition to a website for people who already read tablature, one difference being the lack of solid lines. Online tab applies better for online sites due to every mark on the tab staff can be typed on a 60%-95% keyboard (the standard keyboard for laptops and desktops). The lines for the strings are represented by multiple "-", and the bar lines at the start and end of each measure are represented by "|". The author enters fret numbers between the dashes to convey played notes (Matthies, 2019). There is also a clear lack of quantitative rhythm notation, any indication of special effects such as pitch bends and whammy bar notation, and dynamics.

This text-based form is convenient to enter onto a web page while still conveying notes and chords that are represented on standard tablature, however rhythm accuracy is lost. An author can add rhythm stems and bars to drawings of tablature. However, adding rhythm stems is difficult due to the inability to add solid lines on some processing software. Adding a certain number of dashes between notes proportional to the amount of time that passes between two notes is one possible solution. Closer notes indicate that notes are played sooner, while notes that are further apart indicate more time between notes. While this does grant some insight into simple rhythms of a song, this depiction of rhythm is imprecise, and can be interpreted differently by each player that reads the tablature. Learning a song by ear helps specify the rhythm, but not all songs have audio accompaniment. While all music can technically be learned by ear, this process is often unnecessarily difficult and complex songs will take more time to learn by ear. Overall, online tablature has been useful for users in order to express online tablature effectively and efficiently.

## 2.3 Common Strategies for Learning New Guitar Tablature

Guitar players learn songs from listening to them being played, as well as from tablature and traditional musical notation. Prior to the widespread use of written music beginning in the 1400s, most written music was

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taught primarily through listening and watching (Strayer, 2013). Today, people of all ages continue to learn new music and better identify different notes through listening. With the use of audio recordings and playback features, musicians learn music online. However, learning through listening can be time consuming, particularly in learning pitches, and often requires a process of trial and error (Pecoraro, 2013). Therefore, combining two or more methods of representing music is the most efficient method of learning new songs. Listening to complicated solos assists in their learning process. For example, many classic rock songs feature solos that have complicated notation, representing whammy bars, octaves, pitch bends, and screeching. Listening to these effects, soloists can better interpret music, and be more accurate to the original.

Learning from tablature can make learning the guitar easier for some players. In an article on introducing tablature into middle school classrooms, a guitar teacher recounts his experience with a student when combining both tablature and traditional notation, saying, "I was astonished when he played the entire eight-measure segment perfectly, and I said, 'I had no idea you could read music so well!' He replied back to me, 'Oh, I wasn't playing the music; I was playing the tablature'" (Thompson, 2011). An improved indication of finger placement enabled this student to play with a high degree of accuracy, which they did not accomplish with traditional sheet music.

Furthermore, tablature is useful in teaching musical instruments through video games, despite the player never playing the actual instrument. A study tested the effects of the game *Rock Band* on the musical abilities of those with very limited experience found that there was a transfer of skills from briefly playing *Rock Band* to actual musical skill (Sakkal & Martin, 2019). *Rock Band* introduces the dexterity needed to play guitar along with common tones and pitches that can familiarize players with non-video game guitar sounds.

# 3.0 Methods

The goal of this project was to analyze the efficacy of popular tablature websites as educational tools and identify these websites' features and shortcomings. We used this information to create a guide for beginner and intermediate guitarists by identifying tablature websites with superior organization, large tablature libraries, audio recordings, and additional features that help teach new songs. This project also informed new guitarists on the issues of learning new songs with online tablature websites. To complete the project goal, we accomplished the following objectives:

1. Identify the most popular tablature websites and why guitarists preferred them.
2. Assess each website's features, determining which were popular among guitarists, as well as what was missing.
3. Research effective strategies for learning guitar music and compared them to the strategies employed by popular tablature websites.

The work for these objectives began on June 16th, 2020 and was completed July 9th, 2020.

## 3.1 Identifying Popular Tablature Websites

To identify the most popular tablature websites, we sent two similar surveys to two different music communities. We sent the first survey to the WPI Marching and Pep Band and the WPI Concert Band, and the second survey to the subreddit r/GuitarLessons. The WPI Marching, Pep, and Concert bands consist of 315 college musicians with varying levels of experience, with many having guitar experience. The subreddit r/GuitarLessons consists of 135,000 members with varying levels of guitar experience, though many are not active in the subreddit. We chose these guitar communities because most participants have musical backgrounds and experience reading guitar tablature when learning new songs. Surveying guitar communities such as r/GuitarLessons and WPI music groups, as opposed to samples representing the general population, ensured a high concentration of survey participants with guitar experience. The surveys asked participants their preferred

websites, features, and types of tablature. Knowing these components allowed us to compare websites based on the tools they offer, and the tools that survey participants prefer to use.

We created the survey on Google Forms, as it is user friendly and widely available for participants. We designed the survey to be brief and intuitive, encouraging participant responses to all questions. Most questions on the survey contained multiple choice options, which allowed participants to simply select the option(s) they found applicable, and each multiple-choice question contained a significant number of potential responses, which minimized the instances when participants needed to type an unlisted answer. While some questions required short answer responses due to the individuality of potential responses, participants could sufficiently answer these questions with a single sentence. We sent the survey one questions to WPI music groups, and the survey two questions to r/GuitarLessons (see: Appendix A). The differences in the two surveys, while subtle, resulted in the collection of significantly different data. To create survey two, we updated survey one with an additional question on what methods guitarists use in learning new songs. Survey two provided the additional information of guitarists' most common methods of learning songs. Despite sending our surveys to two separate music communities, we still received limited results. This is likely due to fewer members in WPI music communities being guitar players than we expected, and a lack of interest in our survey among members of the r/GuitarLessons subreddit. As of June 23rd, 2020, survey one received 18 responses and survey 2 received 8. Since the surveys were distributed online, the entirety of our respondents may use the internet more frequently, and therefore are likely partial to online sources of tablature. This preference, however, should not have greatly affected our results, as our project deals solely with online tablature sources. The surveys were sent to two different communities to get a broader demographic and have larger, more diverse set of responses.

## 3.2 Determining Useful Website Features

Identifying each website's features was essential in providing beginner guitarists with a guide to the shortcomings and features of tablature websites. We researched each website that survey respondents reported using, ranked each website on a variety of metrics, and listed the relevant features of each website. We researched GuitareTab, Chordie, GuitarTabs.cc, YouTube, Ultimate Guitar, Songsterr, and Tabs4Acoustic. We

based the metrics on which we ranked each website on features that survey participants indicated as important in tablature websites. We ranked website features using four different methods depending on the type of information we were rating. The websites were given a set of parameters, where lower scores are indicative of a better experience. The first method pertained to the features of a website, for example demos or interactive tablature. As a website can either have or not have any one given feature, we scored this on a ternary numerical scale: zero for websites having a feature, one having varying support, and two not supporting at all. The second method of scoring we used was ranking the websites from one to seven. The third scoring method involved determining the popularity of any given website; this was calculated by taking the total respondents subtracted by how many people used the website. The best score possible was a zero, if all people used a given website; and the worst score possible was 26, the number of survey responses, if no one used a given website. Our last scoring method was for advertising (ads) on the websites, with a range of zero to five. Having a numerical representation of the data collected removed biases, regardless of if they were intentional. The ideal total score of a website was three, with the worst possible score being a 75. To evaluate the features of each website, we viewed the tablature of three songs on each website: Hotel California by the Eagles, Stairway to Heaven by Led Zeppelin, and Nothing Else Matters by Metallica. We selected these songs for their popularity on each website, which ensured these songs' tabs were well maintained by moderators.

To gain further insight into the effectiveness of tablature websites, we conducted an interview with Professor V.J. Manzo. Professor Manzo is a highly skilled guitarist, having played the guitar for 25 years and having experience in instructing students and guitar performance. We chose to interview Professor Manzo because we obtained survey results primarily from beginner and intermediate level players and wanted additional insight from a professional. Professor Manzo provided his personal experiences in teaching beginner guitarists, identifying what methods for learning new songs were most effective for his students and providing his opinion on the efficacy of tablature websites. However, due to time constraints, Professor Manzo was the only expert we interviewed. The interview questions focused on Professor Manzo's experience with online tabs and how he has encountered students' experience with online tabs (see: Appendix D).

With the methods outlined above, we distributed the survey to their respective communities and waited for responses for one week. Following the one-week deadline, we reviewed the participant responses for any significant patterns. The chapter below describes our findings from the survey and interview.

# 4.0 Findings

To both determine the most popular tablature websites and analyze their features, we conducted personal research and sent two surveys to guitar and music communities. We also interviewed Professor V.J. Manzo, a music educator and performer with 25 years of experience on the guitar. By analyzing information gathered from our surveys and interview with Professor Manzo, we derived the following findings concerning guitar tablature websites' shortcomings and features. We received a total of 26 survey responses; 18 from the WPI marching, pep, and concert bands and 8 from r/GuitarLessons.

## 4.1 Popular Tablature Websites

From the combination of surveying music communities and independent research, we have identified Ultimate Guitar, Songsterr, and YouTube as the most popular tablature websites used by online guitarists. As respondents received and completed the surveys through an online medium, we expected the data to reflect a preference for online tablature. As such, 22 of the 26 total respondents preferred viewing tablature online. The three most popular tablature websites among survey participants were Ultimate Guitar, with 19 respondents listing it as a website they used, Songsterr with 8, and YouTube with 7. These results reflect the combined responses of participants from the subreddit r/GuitarLessons, and members of the WPI Marching, Pep, and Concert bands. The highest portion of survey participants identified using Ultimate Guitar in both music communities, however the margin was higher among WPI music groups as 14 of the 18 respondents identified using Ultimate Guitar, compared to five of the 8 r/GuitarLessons respondents.

## 4.2 Preferred Methods of Learning Guitar Songs

Our survey asked respondents their preferred methods of learning the guitar, if they prefer interactive tablature or just standard notation to better our knowledge of guitar players preferred learning methods. In our second survey, all respondents found that slowing the tempo of fast sections is beneficial to learning to play new songs, while learning by ear was much less popular, with only one of eight respondents. However, 22 of 26 respondents preferred online tablature, with only 4 preferring printed tablature or another media source. Of all the responses, only 14 of 26 players preferred interactive features for their tablature overall. After analyzing the

individual responses, beginners tend to prefer interactive features as they are still learning, whereas intermediate and advanced players are more likely to use standard tablature notation. Intermediate and advanced players might find the extra space needed for interactive features could be better used for more tablature instead.

4.3 Ultimate Guitar and Songsterr

Ultimate Guitar and Songsterr provide similar services and are effective tools for learning new guitar songs, assuming users are skeptical about the accuracy of the tablature they view. Both Ultimate Guitar and Songsterr have similar forms of interactive tablature, which include features such as automatic scrolling, audio overlay (guitar audio synced to the scrolling tablature), and variable playback speed, all of which were important to survey participants in learning new songs. By combining a scrolling cursor with an audio sample of a song, these websites also express musical concepts such as rhythm and dynamics to players that do not necessarily read traditional music notation. Of the survey respondents, 18 preferred tablature that indicated rhythms in some way, and 15 preferred tablature indicating dynamics. Additionally, survey participants who listed using either Ultimate Guitar or Songsterr cited the importance of the websites' large tablature libraries, which made tablature much more available, as reasons for their use of these websites.

As we identified through our own personal research and interview with Professor Manzo, these tablature websites also have shortcomings in the accuracy of their tablature. Both Ultimate Guitar and Songsterr are wiki style websites, meaning each website has just a few moderators identifying and editing incorrect content. The only prerequisite for uploading tablature onto these websites is having a free account, meaning essentially anyone can upload content. Since there is no vetting process determining whether a member of these websites has the expertise to accurately transcribe and post guitar tablature, and there are thousands of songs that moderators must regulate, many tablature transcriptions are incorrect. As Professor Manzo also pointed out, guitar transcriptions can be incorrect without ever including a false pitch (V.J. Manzo, personal communication, June 18, 2020). Since any given pitch can be played on as many as 6 different frets on a guitar, transcribing songs incorrectly is easy for any guitarist. At best, incorrect alternate fingerings in transcriptions alter the notes' tone, and, at worst, make playing a song impossible.

4.4 YouTube

YouTube provides seemingly endless content, but as the name indicates, it is focused on the users being on the tube (CRT) TV. This implication allows for some high-quality tablature uploaded by some users, but without a way to filter through everything else the platform provides. As YouTube is single-user oriented, there are limited creator groups from which to find content. This leads to unregulated videos that can provide inaccurate information. Once one finds a channel that they like, typically with one content creator, they know they are receiving consistently accurate tablature.

In our interview with Professor Manzo, we discussed the positives and negatives of YouTube as a guitar teaching platform. Professor Manzo remarked that the best way to learn the guitar is kinesthetically with a teacher, with the next best alternative being YouTube. His choice of YouTube as the best way to learn stems from the dedicated musicians who teach others and overlay tablature with videos of themselves playing along. Although there are some content creators such as -JustinGuitar, Acoustic Life, and Tab Sheet Music- that provide consistently accurate tablature, there are no means to validate their work, leaving only the comment section on each video to assess accuracy of the tablature.

YouTube scored a 53 of 75 (see: Appendix B) but was rated higher than Ultimate Guitar and Songsterr due to the information we gathered from Professor Manzo. YouTube allows for variable playback speed for videos as well. One of the areas where YouTube compared unfavorably was in the duration of interruptions for advertisements during a song. Many "YouTubers" place content on their channels to make money by showing advertisements during playback of their videos. YouTube plays one or more advertisements per song, depending on the length of the video. A user experiences random breaks during a song, with one at or near the beginning of each video. The longest un-skippable ad time run length is 30 seconds per advertisement, for a total of 60 seconds per song.

4.5 Additional Tablature Websites

Although our survey included the websites GuitareTab, Chordie, GuitarTabs, and Tabs4Acoustic, only five people reported using any these websites. No respondents reported using Chordie and Tabs4Acoustic, one respondent reported using GuitarTabs, and four reported using GuitareTab. GuitareTab ranks third overall, and Chordie ties with YouTube based on user-weight. Both Chordie and GuitareTab have a strong list of features (see: Appendix B) that are important for guitar tablature online. However, they are not as popular as the other websites, likely due to the small sample size we gathered.

GuitareTab scored a 48, slightly better than YouTube, as GuitareTab has more consistent features, a better library, small imbedded advertising and no paid option, making it free to everyone. The main reason that it has been pushed down is from Professor Manzo's recommendation for beginners to use YouTube. The only two features that GuitareTab has are a scrolling cursor, and chords, features that are shared with almost all other websites.

Chordie scored a 53, tying it with YouTube. No respondents reported use Chordie, even though the site has more features than GuitareTab with the same advertising. However, Chordie has a smaller library, less accurate tablature, and worse legibility, possibly accounting for its lack of popularity in our survey. The lack of reported users, limited song library, and low accuracy moved Chordie to the fifth best website.

Tabs4Acoustic scored similar to Chordie and YouTube at 54. Although Tabs4Acoustic has more features than GuitareTab along with no paywall, it also has obnoxious advertising on the webpage, along with middle-of-the-road library, accuracy, and legibility. Tabs4Acoustic was our second website with no reported users.

GuitarTabs scored a 61 on our charts, as the only feature that it has is showing chords. Any other features that it does advertise redirect you to Ultimate Guitar. GuitarTabs has minimal advertising, but low accuracy and bad legibility, along with a limited library of songs to choose from brings it down to our last place.

# 5.0 Conclusions and Recommendations

Based on our analysis of the survey responses and an interview, we identified patterns, which led to our recommendations. Ultimate Guitar and Songsterr were the most popular choices on our survey. Respondents cited their variety of musical options and features, as discussed in Section 4.3. While YouTube is not solely for guitar tab, many guitarists learn songs by listening and the site's variable playback speed. The following recommendations and conclusions aim to help guitar enthusiasts who may use these sources and their features.

## 5.1 Ultimate Guitar and Songsterr

Through our own research on popular tablature websites and our survey results, Ultimate Guitar and Songsterr are the most popular tablature websites and reportedly provide the best experience for beginner guitarists. Significantly more survey participants selected Ultimate Guitar and Songsterr than any other website. While more participants report using Ultimate Guitar than Songsterr, participants that used either of the two websites cited the same reasons for using them: the websites' large tablature libraries; and well-organized presentation. Few participants listed using other websites such as tabs4Acoustic or GuitarTabs.cc, likely because these websites do not store tablature locally on their own servers. Both tabs4accoustic and GuitarTabs.cc contain large databases of guitar song titles and their chords and lyrics, but do not feature traditional tablature. GuitarTabs.cc provides a link to view tablature, which redirects the user to Ultimate Guitar.

Ultimate Guitar and Songsterr have similar features for teaching guitarists new songs. Both websites have interactive tablature that allow users to pause and resume song playback, alter a song's playback speed, single out specific tracks of a piece, and follow along with a song using a scrolling cursor. Survey participants listed all of these features as useful in learning to play new songs on the guitar. Unlike Songsterr, however, Ultimate Guitar has an additional feature allowing users to view how to play a song by displaying the neck of a guitar and identifying which frets to play, and when. We recommend Ultimate Guitar and Songsterr to beginner guitarists wanting to learn from online tablature.

## 5.2 YouTube

Unlike other tablature websites, YouTube provides content of almost any genre to users. In this way it is not a traditional tablature website, although it was the third most popular tablature website among our survey respondents. YouTube provides its content in the form of videos that content creators post to their channels. There are wide variations in the quality of different song titles, depending on the author of the tablature. Analyzing the quality of YouTube as a tablature website and identifying its educational features was difficult due to analyze the hundreds of channels offering tab. Regardless of the channel it is posted on, all YouTube videos have the option to slow down to just 25% of the video's normal playback speed and speed up to twice the video's normal playback speed without altering the video's pitch, an extremely useful tool to learning new songs. Other YouTube channels may offer additional methods of teaching guitar songs such as displaying the song's tablature with an audio overlay, or demonstrating the best way to play a passage, though many videos will not have these features.

## 5.3 Recommendations

Despite the educational features that Ultimate Guitar and Songsterr have, we recommend beginner guitarists first seek guitar teachers or professionals to learn new skills and songs. Online guitar tablature suffers for inconsistent accuracy, depending on the tablature's author and editor. Tablature on these websites may also feature correct pitches and rhythms, but with incorrect alternate fingerings that make playing a song difficult or impossible. Identifying not just the rhythms and pitches of a song, but also the ideal fingerings to play a song correctly is difficult for any guitarist, and therefore beginners should only trust tablature recommended by their teacher or a master player.

Should beginner guitarists not have access to a guitar teacher or professional capable of providing tablature, we recommend learning new songs through YouTube. Although YouTube has a smaller tablature selection than websites such as Ultimate Guitar, users can limit themselves to specific channels whose content they believe to be accurate. Channels we have found to contain consistently accurate tablature include JustinGuitar, Acoustic Life, and Tab Sheet Music. The consistency of these YouTube channels eliminates the

issue other tablature websites have of unreliable sources posting tablature. Should beginner guitarists still prefer using Ultimate Guitar for its educational tools, we recommend using only the website's official tabs, as these are regulated by the website's moderators.

5.4 Future Research

Given the limited time of our research period and our project setbacks (see Appendix F), there were several worthy tablature topics which remain unexplored. In future research, we recommend that other groups consider how the educational potential of tablature websites compares to printed tablature sources. Unlike tablature websites, printed works go through a publishing process that may address accuracy issues with tablature website's guitar song transcriptions. Researching the educational benefits of interactive tablature could provide a published database of interactive tablature. Finding ways of efficiently vetting large amounts of online tablature to ensure its accuracy is another worthy endeavor. Providing websites such as Ultimate Guitar and Songsterr with methods of validating their tablature would encourage more guitarists to use these websites.

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# Appendix A: Surveys One and Two

i. How would you categorize your knowledge and skill on the guitar?

 1. Beginner (four chord songs and knowledge of basic chords such as G, D, and C)

 2. Intermediate (understanding of chords and rhythms demonstrated in songs like "Hotel California"

 3. Advanced (can demonstrate complicated picking, and arpeggios at a consistent BPM or are a qualified instructor for students at any level of guitar playing)

ii. What methods do you find most helpful in learning to play new guitar songs? You may select multiple answers*

 1. Slowing the tempo for fast sections

 2. Playing difficult sections on a loop

 3. Leaning by ear

 4. Playing along with a recording of the song

 5. Watching someone else play the song

iii. Which form of tablature (tabs) do you prefer?

 1. Online

 2. Text-based published works

 3. Other

iv. If you prefer online tabs, what websites do you use to view tabs?

 1. Ultimate Guitar

 2. A-Z Guitar Tabs

 3. Songsterr

 4. Chordie

 5. GuitarTabs.cc

 6. Tabs4Acoustic

 7. YouTube

 8. Guitar Lesions

 9. N/A

 10. Other

v. Why do you prefer to use this website?

 1. Short answer question

* Only in survey two

vi.    If you prefer published tabs, what magazines or books do you like the best?**

      1.  Short Answer Question

vii.    Why do you prefer that book or magazine?**

      1.  Short Answer Question

viii.    What type(s) of tablature do you prefer to use?

      1.  Online interactive tab

         a.  (image)

      2.  Chord Box Notation

         a.  (image)

      3.  Tab and standard notation

         a.  (image)

      4.  Other

ix.    What problems or shortcomings have you found in the way musical concepts are expressed in online tablature?

      1.  Scrolling while playing or reading

      2.  Legibility issues

      3.  Tuning to different keys

      4.  Looping certain sections of the work

      5.  Speed of the video / music

      6.  Other

x.    What additional features / musical concepts would you prefer were expressed in tablature?

      1.  Rhythms

      2.  Dynamics

      3.  Bends

      4.  Slurs

      5.  Whammy bar

      6.  Chords plus extensions

      7.  Other

xi.    Do you prefer an interactive web-based form of tablature such as those located on websites like Ultimate Guitar or Songsterr?

      1.  Yes

** Only in survey one

2. No

xii.  Why do you prefer / not prefer interactive web-based tablature?

1. Short answer question

xiii.  Other thoughts or comments regarding tab reading

1. Short answer question

# Appendix B: Website Features

| Website | Ultimate guitar | Songsterr | YouTube | .-Z Guitar Tab | Chordie | Guitartabs.cc | Tabs4acoustic |
|---|---|---|---|---|---|---|---|
| Decreasing/Increasing Tempo | 0 | 0 | 0 | 2 | 0 | 2 | 0 |
| Looping sections | 0 | 0 | 2 | 2 | 2 | 2 | 2 |
| Altered Tuning | 2 | 2 | 2 | 2 | 0 | 2 | 2 |
| (1 being best, 7 being worst) | 1 | 2 | 7 | 3 | 6 | 4 | 5 |
| Lessons/Demos | 0 | 2 | 0 | 2 | 2 | 2 | 2 |
| Audio Overlay | 0 | 0 | 0 | 2 | 2 | 2 | 2 |
| Scrolling Cursor | 0 | 0 | 1 | 0 | 0 | 2 | 0 |
| Accuracy of tabs (1 being best, 7 being worst) | 1 | 2 | 7 | 3 | 5 | 6 | 4 |
| Legibility (from 1 to 7) | 2 | 1 | 3 | 4 | 5 | 7 | 6 |
| Popularity (Weigheted) (for tabs specifically) | 8 | 19 | 20 | 23 | 26 | 25 | 26 |
| Chords | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Metronome | 0 | 0 | 1 | 2 | 2 | 2 | 0 |
| Shows all tracks | 0 | 0 | 1 | 2 | 2 | 2 | 2 |
| Has Paid Subscritption | 4 | 3 | 4 | 0 | 0 | 2 | 0 |
| Advertising | 2 | 1 | 4 | 1 | 1 | 1 | 3 |
| Total | 20 | 32 | 53 | 48 | 53 | 61 | 54 |
| Rank | 1 | 2 | 4 | 3 | 4 | 7 | 6 |

*Table 1: Features of the websites*

# Appendix C: Survey Results

| ID | How would you categorize your knowledge and skill on the guitar? | Which form of tablature (tabs) do you prefer? | If you prefer online tabs, what websites do you use to vi |
|----|---|---|---|
| 1 | Intermediate | Text-based published works | PDFs of tabs |
| 2 | Beginner | Text-based published works | |
| 3 | Intermediate | Online | Ultimate Guitar;Songsterr |
| 4 | Intermediate | Online | Ultimate Guitar;YouTube |
| 5 | Intermediate | Online | Ultimate Guitar |
| 6 | Intermediate | Online | Ultimate Guitar;A-Z Guitar Tabs |
| 7 | Beginner | Online | Ultimate Guitar;YouTube;Musescore |
| 8 | Intermediate | Online | Ultimate Guitar;Songsterr |
| 9 | Advanced | Online | Ultimate Guitar |
| 10 | Advanced | Online | Ultimate Guitar;Songsterr |
| 11 | Intermediate | Online | Ultimate Guitar;http://www.themountaingoats.net/wiki/dok |
| 12 | Intermediate | Online | Ultimate Guitar;Tabs for Acoustic |
| 13 | Intermediate | Online | Ultimate Guitar |
| 14 | Intermediate | Online | Ultimate Guitar;Songsterr;YouTube |
| 15 | Intermediate | Online | Ultimate Guitar |
| 16 | Beginner | I learn best from printed music text | N/A |
| 17 | Beginner | Online | Usually whatever appears first when I google it |
| 18 | Intermediate | Online | Ultimate Guitar;A-Z Guitar Tabs;Songsterr;Guitartabs.cc |

| ID | How would you categorize your knowledge and skill on the guitar? | What methods do you find most helpful in learning to play new guitar songs? | Which form of tablature (tabs) do you prefer? |
|----|---|---|---|
| 19 | Beginner | Slowing the tempo for fast sections;Playing difficult sections on a loop | Online |
| 20 | Beginner | Slowing the tempo for fast sections;Playing difficult sections on a loop;Playing along with a recording of the song | Online |
| 21 | Beginner | Slowing the tempo for fast sections;Playing difficult sections on a loop;Learning by ear;Playing along with a recording of the song;Watching someone else play the song | Online |
| 22 | Intermediate | Slowing the tempo for fast sections;Playing difficult sections on a loop | Online |
| 23 | Intermediate | Slowing the tempo for fast sections;Playing difficult sections on a loop;Watching someone else play the song | Online |
| 24 | Intermediate | Slowing the tempo for fast sections;Playing difficult sections on a | Online |

| | | | |
|---|---|---|---|
| | | loop;Playing along with a recording of the song | |
| 25 | Beginner | | Slowing the tempo for fast sections;Playing along with a recording of the song | Interactive Games |
| 26 | Beginner | | Slowing the tempo for fast sections;Playing difficult sections on a loop;Watching someone else play the song | Online |

| ID | Why do you prefer to use this website? | If you prefer published tabs, what magazines or books do you like best? | Why do you prefer that book or magazine? |
|---|---|---|---|
| 1 | Everything is in a neat form that is east to look at and printable | | |
| 2 | | | |
| 3 | These websites have the songs that I want to learn | | |
| 4 | ultimate guitar has easy to understand tabs and chords for most songs I am looking for and it provides a good starting point when I'm learning to play a song my own way.  Youtube has some good videos that show players hands when I am looking to learn more complicated melodies. | | |
| 5 | It's easy to navigate | | |
| 6 | Has basically evert song in existence | | |
| 7 | Lots of variety | | |
| 8 | Lots of availability of free tabs | | |
| 9 | It's what I've always used and that it seems to be the most open source | | |
| 10 | I've just always used these websites to download tabs for MIDIs and practice | | |
| 11 | I have the UG app on my phone which makes it convenient. I prefer to use the mountain goats tabs directly from the website because I know they are accurate. | N/A | N/A |
| 12 | Several samples of songs | | |
| 13 | Most selection | N/A | N/A |
| 14 | | | |
| 15 | Most selection | N/A | N/A |
| 16 | | | |
| 17 | Convenience | | |
| 18 | they are the first ones that come up when i search the internet for tabs, some also offer chord shapes sometimes | n/a | n/a |
| ID | If you prefer online tabs, what websites do you use to view tabs? | Why do you prefer to use this website? | What type(s) of tablature do you prefer to use? |
| 19 | Varies | | Chord Box Notation |

| | | | |
|---|---|---|---|
| 20 | Ultimate Guitar | | Chord Box Notation |
| 21 | Ultimate Guitar;A-Z Guitar Tabs;Songsterr;YouTube | these are sites that are popular and have a variety of songs + lot of versions per song | Tab and Standard Notation;Chord Box Notation |
| 22 | Ultimate Guitar | has basically every song, formatted decently | Tab and Standard Notation |
| 23 | YouTube | Tab usually comes with a lesson or demo | Tab and Standard Notation |
| 24 | Songsterr;YouTube | Songsterr's ability to slow the tempo to a desired % (50,60,70..) is very good for practising and building muscle memory. | Online Interactive Tab;Tab and Standard Notation |
| 25 | Ultimate Guitar;Games | I can have a direct input to how fast it goes | Chord Box Notation;Game |
| 26 | Ultimate Guitar;A-Z Guitar Tabs;Songsterr;YouTube | | Online Interactive Tab;Chord Box Notation |

| ID | What type(s) of tablature do you prefer to use? | What problems or shortcomings have you found in the way musical concepts are expressed in online tablature? | What additional features/musical concepts would you prefe |
|---|---|---|---|
| 1 | Tab and Standard Notation | Tuning to different keys;Looping certain sections of the work | Dynamics |
| 2 | Chord Box Notation | Scrolling while playing or reading;Legibility issues;Tuning to different keys;Looping certain sections of the work;Speed of the video/music | Rhythms;Dynamics |
| 3 | Tab and Standard Notation | Scrolling while playing or reading;Speed of the video/music | Rhythms |
| 4 | Tab and Standard Notation;Chord Box Notation | Scrolling while playing or reading;Legibility issues;often tabs or chords are made without adhering to a time signature, which leaves flexibility for the player but muddies complex rhythms. | Rhythms;Dynamics |
| 5 | Tab and Standard Notation;Chord Box Notation | Scrolling while playing or reading;Looping certain sections of the work | Rhythms;Dynamics |
| 6 | Tab and Standard Notation;Chord Box Notation | Scrolling while playing or reading | |
| 7 | Tab and Standard Notation;Chord Box Notation | | Rhythms;Bends;Slurs |
| 8 | Online Interactive Tab;Tab and Standard Notation;Chord Box Notation | Scrolling while playing or reading;Legibility issues;Looping certain sections of the work;Speed of the video/music | Rhythms |
| 9 | Tab and Standard Notation;Although I've made the change to written sheet music | Scrolling while playing or reading;Legibility issues;Tuning to different keys;They do not have enough musical information | Rhythms;Dynamics;Bends;Slurs;Whammy bar;Chords plu |
| 10 | Tab and Standard Notation | Scrolling while playing or reading;Not relevant to guitar; but the way drum tabs are represented can be difficult sometimes | |
| 11 | Online Interactive Tab;Tab and Standard Notation | Scrolling while playing or reading;Legibility issues;Tuning to different keys | Rhythms;Dynamics;Chords plus extensions |
| 12 | Chord Box Notation | Scrolling while playing or reading;Speed of the video/music | Rhythms |
| 13 | Tab and Standard Notation | Tuning to different keys;Looping certain sections of the work | Dynamics |
| 14 | Tab and Standard Notation | Scrolling while playing or reading | Rhythms |
| 15 | Tab and Standard Notation | Tuning to different keys;Looping certain sections of the work | Dynamics |
| 16 | Printed music | Hard to read and play | |
| 17 | Chord Box Notation | Scrolling while playing or reading;Looping certain sections of the work | Rhythms;Dynamics;Chords plus extensions |

| ID | What problems or shortcomings have you found in the way musical concepts are expressed in online tablature? | What additional features / musical concepts would you prefer were expressed in tablature? | Do you prefer an interactive web-based form of tablature s |
|---|---|---|---|
| 18 | Tab and Standard Notation;Chord Box Notation | Scrolling while playing or reading;Tuning to different keys;Looping certain sections of the work | Rhythms;Dynamics;Chords plus extensions |
| 19 | Scrolling while playing or reading;Looping certain sections of the work | Rhythms;Dynamics | |
| 20 | Scrolling while playing or reading;Speed of the video/music | Rhythms | Yes |
| 21 | Scrolling while playing or reading;Tuning to different keys | Rhythms;Dynamics;Bends;Chords plus extensions | No |
| 22 | Scrolling while playing or reading;Legibility issues | Dynamics;all of these can be expressed already | No |
| 23 | Ability to print | Rhythms;Dynamics;Bends;Slurs;Whammy bar;Chords plus extensions | No |
| 24 | Legibility issues | Rhythms;Whammy bar | No |
| 25 | | | Yes |
| 26 | | Rhythms;Dynamics;Bends;Slurs;Whammy bar;Chords plus extensions | Yes |

| ID | Would you prefer an interactive web-based form of tablature as opposed to images of tab? | Why do you prefer/not prefer interactive web-based form of tablature? | Other thoughts or comments regarding tab reading: |
|---|---|---|---|
| 1 | No | | |
| 2 | Yes | | |
| 3 | Yes | It can provide more information | |
| 4 | No | I like to be able to read and learn music at my own pace. | |
| 5 | Yes | | |
| 6 | No | Involves pausing/restarting which is more complicated than just memorizing | |
| 7 | Yes | | |
| 8 | Yes | | |
| 9 | No | They seem to hurt more than help | |
| 10 | Yes | I want it to play along with the tab | |
| 11 | Yes | It would better allow me to practice specific parts of songs and know how they should sound without just looking at a flat image | |
| 12 | No | I'm not sure how I would use it | I like reading the actual notes in the music |
| 13 | Yes | Scrolls with the song automatically | |
| 14 | Yes | | |
| 15 | Yes | Scrolls with the song automatically | |
| 16 | No | | |
| 17 | | | |

| 18 | Yes | that would be much easier and let me learn things faster and better | this would solve the biggest issues i encounter |
| --- | --- | --- | --- |

| ID | Why do you prefer / not prefer interactive web-based tablature? | Other thoughts or comments regarding tab reading |
| --- | --- | --- |
| 19 | | |
| 20 | | |
| 21 | i am more comfortable on reading standard tabs (those you can export as a pdf) | |
| 22 | I prefer to work at my own pace | |
| 23 | It doesn't really aid learning if you have to turn on a computer everytime you want to play a guitar | I prefer handwritten tabs |
| 24 | Never used them | none |
| 25 | Input | Game |
| 26 | Easier to check correctness and different tempos. | |

*Table 2: Results from the surveys*

The full responses have been anonymized from their original state. Any information that could lead to identification to any individual(s) has been removed. At the time of response from survey participants a timestamp was created automatically by the software used. To increase anonymity, the survey participants have been placed in a random order. Their timestamp was then removed and replaced by an identification (ID) number.

# Appendix D: Interview Questions

i.    What methods of learning do you find helps students the most? Ex. Slowing down measures

ii.    Outside of the classroom, what do students prefer in terms of self-guided learning?

iii.    When you were first learning the guitar, what method(s) of learning did you find most helpful?

iv.    Do you prefer tablature as opposed to traditional musical notation?

v.    Do you find learning using tablature or standard musical notation more helpful for beginner guitarists?

vi.    When learning new songs, where do you prefer to view tablature?

vii.    Do a lot of your students come to lessons with songs they found online?

viii.    Would you recommend students use online sites to practice scales / chords (more theory stuff)?

ix.    With the current pandemic around, what is the best way you have found to teach students online / how to help them practice more with the assistance of an online educational tool(s)

# Appendix E: Interview Results

## 1. Interview synopsis

Online tab is poorly formatted, often inaccurate, and counterproductive.

Reasoning: Anyone can post any tab, whether they have the experience or not which leads to inaccurate tabs. Online tabs are more like a Wiki where anyone can upload anything. A solution to this would be that the uploads would be vetted by experienced guitarists. An audio analysis tool might not be perfect for guitarists would have to look over tabs which they might not want to bother looking over a Taylor Swift song.

Standard notation is beyond guitar oral tradition. Students should learn tab or other guitar methods like listening to recordings over standard notation.

Listen to the recording is very important, however perfect pitch doesn't always translate to students. Ears are not always perfect. For solos, a good recording is necessary since solos rarely translate well to tabs.

Students need a teacher to figure out how a passage fits on the guitar. Students need to know how to get to the right figure within the context of the passage. Students can play all the right notes in all the wrong places. Technically you could play all notes on one string but there is no reason for it.

It is necessary to pair a student with a teacher and there are resources like Songsterr comments, Fiverr freelancing in order to outsource a passage you want.

## 2. Interview Transcript

**Have you used any online guitar learning tools?**

Interested with the tools for online learning the guitar.

Have not used many (if any online tools).

Does not use them as the tabs are poorly formatted, and not well put. 15-year-old twerps

It can be frustrating to use tabs as there are a multitude of places to play the same notes. All the right notes in all the wrong places. The guitar community is riddled with that.

You have a lot of students that can come in with these wrong tabs.

No one ever said, 'let's turn to the next page of tab.' Most people don't read standard notation, and more guitar players don't play using tabs, they more so learn by ear, kinesthetic learning. Not necessarily a good approach, but it is what they will do.

When something is incorrect in the tab, everything can be out of place. You will often need a teacher or seasoned guitar player with perfect pitch to help you.

**How would you combat in this current situation of online learning? In other words, if you have another piece of music, how will you teach them this in an online format?**

The workflow with this would be to rely on your ears, just try to learn by ear, ant this is a difficult problem to tackle as you are not there in person. If you are playing a bar chord, then turn it into a major bar chord, a very common guitar shape they should know. As a guitar player you would know this, but it will take someone knowledgeable to help teach that to someone else. For a beginner to play that, they don't really know the whole context to be able to play all of those notes.

You can play all of the notes all on one string.

Technically you can do that, but you should not be doing that, it is not the best way [how do you represent that on an online format]

Are there multiple ways to represent that information.

Do they present a background notation

Has used Songsterr once or twice to figure out a song to get started with a song.

Most older songs (70s80s) can be muddy. They are not tell transcribed. Some have where the positions are, but the notes are wrong. The technology has fallen short, where you have to listen to the music. It is a very in person thing, requiring a special person to transcribe the audio, not just your average joe or kid being able to do that. Having random people able to upload things, your higher end people will have problems with the songs that are done wrong, but the time commitment to be able to transcribe songs correctly can be very laborious and time consuming.

How do you get the right person to the right authority figure.

Idea: The fiverr, that site of outsourcing a job to a bunch of different people. You can pay 10 people 10 dollars to transcribe one passage, and get a multitude of differences between what the other people view for that. Have a vetting process to be able to go through people who do not know what they are doing to filter them out.

Something like indeed where they have a questionnaire/test thing to be able to verify that they are doing an assignment and doing it correctly to filter out people who might not know what they are doing.

Even if you have ten people who are verified, how will you get (incentivize) them to make transcriptions of out-of-the-park songs that are out there.

He would not touch these sites even if they had the cure to corona (WHO Team; Health Emergencies Proparedness and Response, 2020)

Are the people who go to tab sites, are they just beginners, what is the demographic of those who visit those sites.

Drag on little items for stuff, getting hit with adverts, foibles with little things

'vegan ad from thing bought off of amazon'

Getting teachers to weigh in on the subject, also get others who have insights about this topic as well.

If the people you want to meet are the ones who already use tabs, we are going in the correct way. If we are trying to get information on beginners, we should contact teachers who are on an online environment.

He personally has used standard notation since a senior in HS. He is one of a few who do prefer this. He does not think that the current notation is not that good. It is hard to come up with a new system that is good; and it is just antiquated and weird.

# Appendix F: Overcoming Obstacles

Bill Gates famously stated, "Success is a lousy teacher. It seduced smart people into thinking they can't lose. It's fine to celebrate success but it is more important to heed the lessons of failure" (Carlson, 2012). The ability to shift focus on a moment's notice when everything goes awry is crucial to making a successful project. Failure can happen at any point. This is not indicative of bad ideas or malicious intentions, and the IQP is not immune to failures or setbacks. Failures in life are the cornerstone to success; paving the way to success that you cannot yet see. One example is the origins of this project; having been planned to be: "The Organization and Syncing of Jimi Hendrix's Guitar Works with a Tablature Representation." We have changed our project multiple times for a variety of reasons. Over the last fourteen weeks we have changed and formed our project into its current state. Our group has continually changed the project because of the COVID-19 pandemic, a lack of time, deadlines, and our own inexperience. Most of these roadblocks were often unseen and difficult to plan for. The idea of our original project being in London was ended by the pandemic. When we were given a new project, found at the bottom of Appendix F, we did not get clarity on the copyright law and whether we could use Jimi Hendrix's music until three weeks into our preparation course.

Hours of hard work and labor can be shut down at the snap of a finger. While it might be difficult to accept, all the lost work can be beneficial in the long run when the failures lead to future successes. "I haven't failed -- I've just found 10,000 that won't work." Thomas Edison said this referring to all the times he tried to make a lightbulb. It was not that these 10,000 attempts were failures, he learned from what went wrong and eventually invented the first lightbulb that changed the world. While the setbacks and roadblocks we faced were not cut and dry, we faced two main issues with our project that molded our IQP into what it is now. Throughout this appendix we will describe our original project, along with the troubles we faced throughout the IQP process.

## 1. The Hendrix Project

The Hendrix project was the project selected by our group members from a list of 8 other. The goal of this project was to develop a digital educational tool that would assist the music education community to address the lack of access to, and the lack of a generalized understanding of, Jimi Hendrix's guitar work. Our group was excited to have fourteen weeks to tackle this issue. After a few weeks of research and many emails to the WPI legal department we found out we do not have the rights to use any of Jimi Hendrix's music, name, or likeness. After another couple days of research, we learned that it would take more time and money to get the rights to Hendrix's music. Hendrix's music and everything else he owned is now copyrighted by the Experience Hendrix, L.L.C., owned and operated by Hendrix's family. Simply using likeness of Jimi Hendrix in our public facing project could be the grounds for a suit against our team members, and WPI if they were to host anything tied to it. The actual legal issues preventing us from using Hendrix's work in our project is described below.

## 2. Legality Issues

Copyright law itself is long and complicated; there is a good reason you pay top dollar for lawyers to make sure your created material is protected, and that you are not infringing on other people. The United States Code (U.S.C.) is the culmination of 53 Titles for: "…the codification by subject matter of the general and permanent laws of the United States" (United States Government Publishing Office, 2020). The 17th Title, initially adopted in 1947 for the use and protection of created works, under the guise of copyright. Since its inception, U.S.C. Title 17: Copyrights have been added to as technology has progressed, along with changing when works become public domain. In more recent years however, there have been complicated stances on what one person can use, whether for or not towards personal gain; i.e. should a teacher showing a movie in a classroom be held to the same legal ground that a movie theater is? This is where Title 17 §107 is able to help you distinguish this difference. U.S.C. 17 §107: Fair Use under Copyright law states in what cases you can lawfully use copyrighted material, and if you can have personal or financial gain from using that material. One example of this sweeping the newsrooms in Spring to early Summer 2020 in the United States is the use of songs such like "Panic! At The Disco" or the Family of the late Mr. Tom Petty ordering cease and desist letters

to Mr. Donald Trump for the use of songs in a campaign rally. As §107 states: "fair use of a copyrighted work, including such use by reproduction in copies or phonorecords or by any other means specified by that section, for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research, is not an infringement of copyright" (U.S.C 17 §107). If you have ever seen a moving review of any piece of cinematography, art remarks on the news, video game critiquing, &c… it is only able to exist, and help the creator of the secondary work due to that one sentence above.

Our original project descriptor, in full text below∗, can be read as the documentation and syncing of audio and tablature representation, displaying the collected pieces onto a digital educational tool. Unfortunately for us, the collection of the late Mr. Hendrix's works, and tablature representations -not created by us- would be libel to multiple cease and desist orders; as well to WPI and any other accompanying party members. One the ways to get around this would be the use of a tool like online renters' assurance, where one party can digitally rent the work like a library. However, in this case we would still have to have physical copies of each piece and may only rent out digitally to the amount of physical copies we have (i.e. we cannot digitally rent 10,000 copies of Jane Eyre if we only have one copy physically). As the time permitted to make a tool as such is not possible with one CS major and would be closer to a CS MQP all in itself, this option is off of the table; before we find and locate any copies of music and tablature.

The second option we would have is to move forward with using copyrighted material and claim that it falls under fair use. In this case we have to see where we fall to the four axions; purpose, nature of the copyrighted work, amount of use, and effect on the market. For point (1) we are all set as we are producing this tool for nonprofit educational benefits for the greater good of mankind. However, points (2) through (4) for us would be non-contenders. As for point (2), the work we would be using is still under copyright -and will be for some time- so we continue onwards. Point (3) relating to how much copyrighted material we will use, and the answer to that is all of it. Even if we only used part of a song, it may still be liable to civil law suits (Skidmore V. Led Zeppelin En Banc, 2019) or (Gray V. Perry, 2014). The music and tablature is all copyrighted materials, and we would be using the full works, not snippets. As for point (4), this could be debatable as the effect would be unknown to us. As a team, we do not possess the ability to run a market-research effort into the Jimi Hendrix community to figure out if we could gain the rights to use his work.

## 3. The Website

As mentioned below, our original project entailed making a digital educational tool, with the internet being one of the best teachers for widespread learning. This second project with a website would get around all the legal problems of having copyrighted music and syncing tablature. The idea was for the end-user to upload music to a website, parse through it with a machine learning algorithm, create a tablature representation, and then play it back to the user in real time. We This takes away all problems with legality as we would never store any copyrighted work on our side, and anything analyzed would be on the end-user's system only. We essentially would have made a guitar tuner that stored values over time; and using pre-curated works and the use of professionals to get finger placements down, creating a more efficient source of tablature representation. We have most likely lost you, dear reader, in a few places there with technical jargon I have not time to define to you; illustrating how that would be a bad social project. While this project sounded fantastic and we had confidence in ourselves, we were being overly ambitious. After a brief period, our advisors told us this project is too complex and lacks a social aspect and we had to come up with a new idea.

Our new idea was to create our own online interactive tablature based on the desired preferences of beginning guitarists. We created a website that had a working prototype of our interactive tablature and some other features useful to beginning guitarists. We used a survey to get what guitarists wanted out of tablature, making recommendations to websites like Ultimate Guitar and independent creators on YouTube to how to make the most effective tablature with the resources they have. During our research we found Ultimate Guitar

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has similar features to what we currently had in beta testing. Because what we were creating already existed, we had to create a new project. That is how we arrived at where our current project is.

4. Lessons

While failure is perceived by many as a negative result or an undesirable outcome, it can teach strength, flexibility, and resiliency. Through the course of our project as we kept having to change our scope or the whole project all together, but with every change we were strengthening out adaptability and problem-solving skills. We had brainstormed two to three times more projects than we ended up trying. As the COVID-19 pandemic swept across the world, international IQPs were canceled (for E-Term 2020), new projects were devised by the project advisors. With your original project working out to not be viable, we were the ones coming up with new idea for our project. And through many drafts of all our different project covered in 'red ink' and sleepless nights we reached the finish line.

As a group we felt so much animosity towards our project, and the online IQP experience. With all that happened around COVID-19 and the cancelations of off campus IQPs, most of our roadblocks were no one's fault. Changes in the world around us is always changing and we can learn how to adapt. Our experiences through this project has taught each of us now to stay on our toes so we can now try and anticipate rather than react. We learned that we need to make sure that we check the legality of our work and not just blindly trust that what we were given is doable. We also learned to do better market research because if we had been more thorough, we could have saved ourselves a week or two on a dead project. Knowing that what you are doing is going to be useful and people will want it is key in creating. We missed one detail on a single tablature site and because of that we proceeded with project we eventually had to dump. Had one of us seen this sooner we could have moved on quicker and had more time to complete this version of our project.

The online IQP prosses combined with the restrictions of the COVID-19 pandemic made the whole project painful and stress inducing. Although the entire IQP project was over the span of 14 weeks, much of that was spent on other variations of this project. Fortunately, all our projects had a similar theme, so we were able to use some of our old research and most of the survey results. Even with that it was still a struggle to finish all we had to do in this time. We hope our negative experience is an outlier, but to any other groups struggling we recommend taking some deep breaths and take the project one step at a time. Each of us would get into our heads and spin out thinking of all that we had to do, but once we took a step back and just focused on the task in front of us, we found it was manageable. To anyone thinking of doing online IQP, we highly recommend you do not! While our experience was stressful and difficult, we did learn a lot about tablature and about handling fluid projects and we are all better prepared for the future.

Below is our original project description for reference.

**Project 5: Developing a digital educational tool for the greater understanding of Jimi Hendrix's guitar work**

In past decades, many works by the 20th century's greatest electric guitarist, Jimi Hendrix, have been transcribed, in conventional musical notation and in guitar tablature ('tab'), with great accuracy. But these useful works remain largely inaccessible to many who do not read music. The team will develop a tool that will enable a user to access transcriptions in a variety of ways (not only by album or song title, but perhaps by recording date as well, for instance). Perhaps the team will develop a way to synchronize recordings of Hendrix to tablature, so a user can see the notes Hendrix plays displayed in real time on a scrolling (video) transcription: there are some examples of this sort of thing on YouTube.