AI's impact on intermediate music production – mixing and mastering

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Abstract

The music industry is a complex network of people and organizations, and the evolution of technology is progressing at a rapid pace. As a result, music production has become more accessible and increasingly straightforward due to more innovative and advanced techniques such as artificial Intelligence (AI).

AI has been part of the music industry for several years now and it is crucial to conduct research to determine which areas of the industry will be most affected by AI in the future. It can be challenging for certain individuals to identify the specific roles within the music industry that AI is currently impacting the most. Therefore, the research is focusing on music production's post-processing methods and AI's impact on mixing and mastering from the point of view of intermediate music producers.

The research used qualitative data analysis to identify themes and patterns in the data. The research was done by conducting semi-structured interviews on two self-identified intermediate music producers. By interviewing intermediate music producers, the researcher sought to gain valuable information and a deeper understanding of AI's impact on mixing and mastering specifically on intermediate music production.

According to the intermediate music producers, mixing and mastering processes are greatly affected by AI. It can help individuals to achieve professional and high-quality sounding songs and albums quickly without the need to educate themselves to learn mixing and mastering or without the need to hire a professional audio engineer to do it, which can sometimes be costly especially for individuals who are not at professional level regarding the skills of music production. Especially AI-powered mastering platforms such as eMastered have helped these individuals tremendously to reach a desired level of final product. Although AI has mostly a positive impact on mixing and mastering on intermediate level, it can lead to inconsistencies in the final sound, homogeneity, and lack of human nuance especially when composing an album that focuses on multiple different musical genres.

Due to the interviewee's little knowledge about AI relations to mixing, the research was not able to answer the mixing aspect comprehensively enough regarding AI's impact on mixing. Therefore, researching the topic of AI's impact purely on mixing in intermediate music production could give valuable information about the phenomena that was not properly answered during the research. Overall, data collected from small sample size of individuals can affect the results and cause them to not be generalizable to larger population. Researching the same topic of AI's impact on mixing and mastering or AI's impact purely on mixing with larger sample size could lead to more accurate and better results regarding the phenomena.

Keywords/tags (subjects)

Artificial Intelligence, AI, AI-powered mastering platform, Music, Music Production, Mixing, Mastering, Post-processing, Intermediate music producer

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Description

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Tekoälyn vaikutus keskitason musiikintuotannossa – miksaaminen ja masterointi

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Tiivistelmä

Musiikkiteollisuus on monimutkainen verkosto ihmisiä ja organisaatioita, ja teknologian kehitys etenee nopealla vauhdilla. Sen seurauksena musiikintuotanto on tullut helpommin saataville ja yhä suoraviivaisemmaksi innovatiivisten ja kehittyneempien tekniikoiden, kuten tekoälyn ansiosta.

Tekoäly on ollut osa musiikkiteollisuutta jo useiden vuosien ajan, ja on tärkeää tutkia, mitkä osa-alueet musiikkiteollisuudessa tulevat olemaan tulevaisuudessa eniten tekoälyn vaikutuksen alaisia. Yksilöille voi olla haastavaa tunnistaa, mitkä musiikkiteollisuuden tarkat roolit ja alat ovat tällä hetkellä eniten tekoälyn vaikutuksen alaisia. Tästä syystä tutkimus keskittyy musiikintuotannon jälkikäsittelymenetelmiin ja tekoälyn vaikutukseen miksaamisessa ja masteroinnissa keskitason musiikintuottajien näkökulmasta.

Tutkimus käytti laadullista datan analyysia teemojen ja kaavojen tunnistamiseen. Tutkimus tehtiin suorittamalla puolistrukturoituja haastatteluja kahdelle keskitason musiikintuottajalle, jotka ovat itse tunnistaneet itsensä tähän ryhmään. Haastattelemalla keskitason musiikintuottajia tutkija pyrki saamaan arvokasta tietoa ja syvempää ymmärrystä tekoälyn vaikutuksista miksaamiseen ja masterointiin erityisesti keskitason musiikintuotannossa.

Keskitason musiikintuottajien mukaan tekoäly on vaikuttanut suuresti miksaamis- ja masterointiprosesseihin. Se voi auttaa yksilöitä saavuttamaan nopeasti ammattimaisen ja korkealaatuisen äänenlaadun kappaleissa ja albumeissa ilman heidän tarvettansa opiskella tai opetella miksaamista ja masterointia itse. Haastateltavat kertoivat, että vaihtoehtoisesti ammattitaitoisen ääniteknikon palkkaaminen tekemään masterointiprosessi voi olla kallista erityisesti niille yksilöille, jotka eivät ole ammattilaisia musiikintuotannon taitojen suhteen ja jotka tuottavat musiikkia pääsääntöisesti omatoimisesti. Vaikka tekoälyllä on pääasiassa positiivinen vaikutus miksaamisessa ja masteroinnissa keskitason musiikintuottajilla, se voi johtaa epäjohdonmukaisuuksiin lopullisessa äänentoistossa, homogeenisuuteen ja ihmismäisten vivahteiden puutteeseen, etenkin työstäessä albumia, joka keskittyy useisiin erilaisiin musiikkilajeihin eli genreihin.

Haastateltavien tekoälyyn ja miiksaamiseen liittyvien vähäisten ja puutteellisten tietotaitojen sekä tuntemusten vuoksi tutkimus ei pystynyt vastaamaan kattavasti tekoälyn vaikutuksista miksaamiseen. Siksi tutkimus, joka keskittyisi pelkästään tekoälyn vaikutuksiin miksaamisessa keskitason musiikintuotannossa voisi antaa arvokasta tietoa ilmiöistä ja asioista, jotka jäivät huonosti vastatuiksi tämän tutkimuksen aikana. Kaiken kaikkiaan pienestä yksilöjoukosta kerätty data voi vaikuttaa tuloksiin ja johtaa niiden soveltumattomuuteen suuremmassa väestöryhmässä. Saman aiheen tutkiminen tekoälyn vaikutuksista miksaamiseen ja masterointiin tai pelkästään miksaamiseen suuremmalla otoskoolla voisi johtaa tarkempiin ja parempiin tuloksiin ilmiöistä.

Avainsanat (asiasanat)

Tekoäly, Tekoälyä hyödyntävät masterointialustat, Musiikki, Musiikintuotanto, Miksaaminen, Masterointi, Jälkikäsittely, Keskitason musiikintuottaja

Contents

Figures

1 Introduction

1.1 Background

The music industry is a complex network of people and organizations that play a role in the creation, production, distribution, and marketing of music (Weng & Chen, 2020). This network includes for example songwriters, composers, performers, producers, record labels, music publishers, distributors, concert promoters, agencies, and retailers (Weng & Chen, 2020). In addition, the music industry consists of people and organizations that sell and manufacture musical instruments (Weng & Chen, 2020). Providing services such as education and training is also considered as part of the music industry.

The evolution of technology is progressing at a rapid pace, advancing quickly and steadily. As a result, music production has become more accessible and therefore more innovative and advanced techniques are being used (Weng & Chen, 2020). The process of creating music has become increasingly straightforward, and new methods are being applied. Technologies such as artificial intelligence (AI) can make it easier for new music producers to enter the industry (Weng & Chen, 2020).

AI has been part of the music industry for several years now, and its importance is rapidly increasing (Bonnici, Dannenberg, Kemper & Camilleri, 2021; de Mantaras & Arcos, 2002). Despite the awareness of AI's existence, it is challenging to identify the specific roles within the music industry that AI is currently impacting the most. Therefore, it is crucial to conduct research to determine which areas of the industry will be most affected by AI in the future.

1.2 Motivation for the research

The music industry is a vast field of entertainment that relies heavily on human interaction, as it has always been driven by human creativity. With the increasing popularity of AI in various aspects of people's lives, it is intriguing to explore the relationship between AI and music and more specifically the music production and its post-process such as mixing and mastering. While AI has proven to have multiple positive effects on music production, assisting producers, songwriters, and event organizers (Birtchnell, 2018), there are also several negative aspects to consider. AI is so intelligent

that it has replaced many jobs outside of the music industry as well due to its efficiency and cost-effectiveness (Birtchnell, 2018), and therefore researching the impact of AI on music production and post-production (mixing and mastering) can provide valuable insights regarding the current state and future state of the industry. Artistic processes such as music creation, painting and dancing are all creative processes, so it is interesting to observe and draw conclusions about the phenomena that has already been occurring in this specific field and decode what the future might hold for music and AI and more specifically mixing and mastering. Can AI for example be truly creative or is it just powered by humans feeding it with massive amounts of data?

As a DJ and as an intermediate music producer, the researcher has a deep appreciation for the role of technology in the music industry and heavily relies on it. To keep up with the latest trends, the researcher frequently relies on cutting-edge computer programs and platforms that are designed specifically for music production. In recent years, AI has emerged as a powerful tool in this field, with the potential to transform the way music is created, distributed, and consumed (Collins et al., 2021). Given the growing importance of AI in music production, it is essential to understand how this technology impacts different aspects of the creative process. By conducting research in this area, the researcher aims to gain fresh insights into the ways in which AI is changing the face of the music industry and more specifically the music production and its post-production processes, mixing and mastering. This knowledge will be valuable not only to the researcher but also to other intermediate music producers as well as music industry beginners and professionals who are grappling with the implications of this transformative technology. By exploring and conducting this research in the intersection of AI and music production and more specifically the process of mixing and mastering, the researcher hopes to contribute to a deeper understanding of the opportunities and challenges that lie ahead in this exciting and rapidly evolving field.

1.3 Research questions

The researcher started to investigate the topic of the impact of AI on music, and specifically music production, mainly based on the researcher's own interests. The researcher personally feels that AI has a significant impact on the post-production processes of music production, especially mixing and mastering, so there is a need for further research on the topic. That being said, post-production processes or post-production processing in this research is referring to mixing and mastering,

mixing only or mastering only, depending on the specific context. Considering the researcher's musical background from various hobbies and work experience, it was interesting and meaningful to focus on these effects specifically from the perspective of intermediate music producers. For this reason, the topic of this research became *"AI's impact on intermediate music production – mixing and mastering."*

In this research an intermediate music producer is considered as someone who is semi-skilled individual in the field of music production who creates music using digital tools and software. Intermediate music producers are beyond the beginner stage of learning but still have room to improve and develop their skills further. Depending on the individual, they typically have a good understanding of music theory and somewhat decent understanding of the technical aspects of production such as mixing and/or mastering. Intermediate music producers are also often able to manipulate audio and use effects in several ways to create unique sounds and they may have experience working with different genres of music and are capable of creating their own original compositions. In short, an intermediate music producer is a semi-skilled musician and technician who uses technology to create and shape music in a creative and unique way but still has room for improvement in more advanced areas of music production such as mixing and mastering, which are considered as post-production processes in the field of music production.

This research seeks to answer the research question*: "How is AI affecting mixing and mastering processes of intermediate music producers in music production?"* or in other words: *"How is AI affecting the intermediate producers' post-processes in music production?"* and the goal is to richen the already existing knowledge about the topic and possibly gain new insights regarding the occurring phenomena. This is done by interviewing intermediate music producers and based on their answers and data collected the researcher seeks to make observations and answer the research question.

1.4 Structure of the thesis

The first chapter is Introduction. Introduction Introduces the topic and the research question, provides background information, and outlines the objectives and scope of the research. It includes a clear statement of the research question and an explanation of the significance and contributions

of the research. Introduction sets the stage for this research and provides the reader with an understanding of the research question, significance, and scope.

The second chapter is Literature review which provides an overview of relevant research and theories related to the topic. It critically evaluates and compares already existing research and identifies areas where more research is needed. This chapter aims to introduce the most important themes related to this research in a clear way by observing the existing knowledge and literature. By starting the discussion from more general topics related to this research and then narrowing them down to more precise relations between variables, it will serve as a guide to the reader.

The third chapter is Methodology, and it describes the research design, methods, and procedures used to collect and analyze data, including all the tools that were used in the process. Methodology explains how the research question will be addressed, including the population, sample, and sampling procedures. Methodology also provides a justification for the chosen methods and explains how they address any potential limitations or biases. The Methodology chapter seeks to address any ethical considerations related to the research, including informed consent, confidentiality, and potential risks to participants.

The fourth chapter is Results and it is the most straightforward chapter in this research. It presents the findings of the research in a clear manner and utilizes figures while doing so. Results chapter is organized and structured in a way that allows the reader to easily understand and interpret the results. Results focus purely on answering the research question with the information gained from the data collected during this research.

The fifth and the final chapter is Discussion. Discussion summarizes the main findings and their significance and discusses the possible implications for future research as well as practical contributions. This chapter reflects the findings back to the research objectives and research question and highlights the significance and contributions of the research. It provides a coherent and well-supported argument that draws on the evidence presented in the previously mentioned Results and Literature review chapters and also considers the limitations of this research. Discussion demonstrates the researcher's ability to critically evaluate the research findings and their broader implications.

2 Literature review

This research focuses on AI's impact on mixing and mastering. AI, mixing and mastering are all separate concepts on their own, but AI has been proven to have an effect on the processes of mixing and mastering (Birtchnell, 2018). It is important to understand separate concepts related to the research before diving deeper into the research topic in question.

To make a systematic literature review, the researcher wanted to open the terms that are included in this research first as separate concepts before connecting them together as a common concept. AI can be seen as a tool and as an industry changing technology especially in the field of music production (Sterne & Razlogova, 2019). Researcher seeks to connect AI with the terms that are mentioned as separate concepts in the upcoming literature review's subchapters.

Therefore, it is important to first take a look at the bigger picture and then narrow and combine it down to the topics that are most important and most relevant regarding the research's topic and research question. This helps the reader to understand what are going to be the focus points and main takeaways of the research based on the literature review that first discusses briefly about the main terms and then delves deeper to talk about the most important concepts related to the topic.

Keywords have been used extensively, and sources have been sought from peer-reviewed literature. By searching for information using the keywords mentioned in the abstract both together and separately, the goal has been to achieve the most comprehensive understanding that guides the reader and introduces the topic under investigation. In this research, already existing literature that examines the same or similar topics as this research has been sought so that it would be possible to compare and review own results and findings based on previous peer-reviewed literature and complement the information. A thorough review of previous literature helps the researcher and reader to understand the already well-known perspectives and observations, and it can also bring out new ideas, perhaps suggesting that a particular topic might deserve further research.

2.1 Mixing and mastering as parts of music production

Mixing and mastering are two distinct stages in the production process of a musical piece, each with its own specific tasks and goals.

In music production, the main goal of mixing is to create balance between individual audio tracks such as guitar, piano and drums before the musical project as a whole is being exported into a single audio file format such as .mp3 or .wav, often referred to as a song (Harrison, 2012). Mastering on the other hand is the process that is being done after those previously mentioned individual audio tracks are combined into a single audio file that together create the song (Collins et al., 2021). The main goal of mastering is to make the song into a coherent outcome that makes final product loud and as high-quality as possible and follows the criteria of a “radio-ready song” that is considered to be ready for distribution and publication (Collins et al., 2021).

In summary, mixing is the process of combining individual tracks into a cohesive mix, while mastering is the final step of preparing that mix for distribution, optimizing it for various delivery formats, and ensuring consistency and compatibility.

2.1.1 Mixing

Mixing is the process of combining multiple tracks, such as vocals, instruments, and sound effects, into a cohesive and balanced stereo or surround sound mix (Harrison, 2012). The mixing process is typically done by a mixing engineer, who works with the raw recordings of individual instruments and vocals to create a full and polished sound (Harrison, 2012). Achieving an overall balanced sound across all of the individual audio tracks inside of the music project is the cornerstone of mixing. Mixing process involves ensuring that the frequencies of different instruments do not overlap with each other in a harmful way (Harrison, 2012). By taming or boosting certain elements of the individual tracks and fine tuning the volume levels allows the most important aspects of the song to together create a well-balanced mix (Harrison, 2012).

On top of taming the frequencies and adjusting certain volume levels, there are several other aspects in mixing as well such as automation and other parameters which seek to create for example space or tension in the mix if needed (Harrison, 2012). Overall, the goal is to achieve a clear mix from which the separate instruments and elements are easy to distinguish (Harrison, 2012). After

a well-executed mixing stage, a song or an album should sound good on different audio devices and platforms such as speakers, headphones and even car.

Mixing is essential process in music production because it can significantly impact and affect the mastering process as well in either positive or negative way, depending on whether it is done correctly or incorrectly. Making sure and ensuring that mixing is done correctly and precisely before preparing the song or an album ready for mastering process is important because it will have a big impact on the final version of the song or an album and can be greatly influenced by it. Therefore, the individual audio tracks in mixing process must be handled with care to avoid inconsistencies in the final sound before entering the mastering stage.

2.1.2 Mastering

Mastering is one of the two stages of post-production processes in music production besides mixing and it is being executed after the mixing stage of a musical piece. It is the last step in music production before a musical piece can be distributed to different formats like CD or vinyl (Sterne & Razlogova, 2019). The goal of mastering stage is to achieve a coherent and consistent sound in the mixed audio file. Instead of focusing on the elements of multiple audio tracks of individual project like in mixing, mastering focuses on the single audio file that is a combination of those multiple audio tracks of a single project that together create the song (Sterne & Razlogova, 2019). The mastering process seeks achieve certain criteria of a high-quality and well-produced sound so that the final product is considered as suitable to be published on various different music streaming platforms such as Spotify.

This can involve ensuring that the audio meets technical requirements for the format, such as the correct bit depth and sample rate, and encoding the audio in a specific file format (Collins et al., 2021). During mastering, an experienced audio engineer, known as a mastering engineer, uses specialized equipment and techniques to enhance the audio of the mix (Sterne & Razlogova, 2019). This can include adjusting the levels and overall tonal balance, equalization, stereo imaging, dynamic range and loudness of the mix as well as adding final processing such as compression, limiting, and dithering (Birtchnell, 2018; Sterne & Razlogova, 2019).

The mastering engineer's goal in mastering is to optimize, balance and enhance the overall sound quality of the final mix for the specific delivery format, making sure that the final product is optimized, consistent and compatible across different playback systems and platforms and meets certain technical standards (Collins et al., 2021). In other words, mastering process seeks to achieve a consistent sound and volume level across all tracks in an album, and make sure that the music sounds great on any audio system, from high-end studio monitors to earbuds (Birtchnell, 2018). “Mastering engineers are the last line of ears before sound comes out of speakers” (Sterne & Razlogova, 2019).

Mastering plays a crucial role in the production of high-quality music, as it helps to ensure that the final product is consistent, polished, and sounds great across all platforms and playback systems.

2.2 Artificial Intelligence (AI)

The term Artificial Intelligence or in short AI was first introduced in the 1950s but still there is no single universally accepted definition of AI (Duan, Edwards & Dwivedi, 2019). However, AI is term used for highly developed computer programs and technological systems that can perform tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and natural language processing (Duan et al., 2019; Lu, 2019).

AI involves creating algorithms and computer models that can learn from data, make predictions, and take actions based on their learning (Birtchnell, 2018). This is achieved through machine learning, deep learning, and other techniques that enable computers to analyze vast amounts of data and identify patterns and insights that would be difficult for humans to discern (Duan et al., 2019; Lu, 2019).

AI aims to create intelligent machines that can perceive, reason, and act autonomously, with applications in a wide range of industries and domains, from healthcare and finance to transportation and entertainment (Lu, 2019). The interaction and collaboration between AI and humans are thus widely visible, very versatile, and far-reaching in our everyday life.

2.3 Artificial Intelligence (AI) in mixing and mastering

Since its inception in the 1950s, AI has been an essential component in the development of computer music throughout its history and it has been a vital factor especially in the field of music production (Bonnici et al., 2021; de Mantaras & Arcos, 2002). The final stages of music production before a musical piece is being released are mixing and mastering, which have a significant impact on the overall outcome of the music.

AI is increasingly being used in the mastering process in music production. The use of AI in mastering allows for a more efficient and cost-effective way to process audio and can also offer some advantages over traditional mastering methods (Birtchnell, 2018). One way AI is used in mastering is through automated mastering software, which uses machine learning algorithms to analyze and process audio (Sterne & Razlogova, 2019).

AI is also capable of providing various different tools such as mixing related tools that can notice and find inconsistencies in the mix and give instructions to the audio engineer or music producer about the parts of a musical piece that needs mixing or mastering (Birtchnell, 2018). For example, AI detecting unnecessary or unwanted frequencies in certain areas of mix such as high, medium, or low range of sounds can be classified into this category. This helps the individuals working on the musical projects to make the needed adjustment with the assistance of AI and can therefore help these individuals to avoid for example muddiness and polarity in the mix (Birtchnell, 2018).

Another way AI is being used in mastering is through the creation of AI-generated music. This involves using machine learning algorithms to analyze and learn from existing music and create new compositions which can be difficult to distinguish even from music production made by humans (Weng & Chen, 2020). While this approach is still in its early stages, it has the potential to revolutionize the music production process, as AI-generated music can be created faster and more efficiently than human-generated music.

Overall, AI is having an impact on the mastering process in music production, offering new tools and approaches for creating high-quality and polished mixes. While AI cannot replace the creativity and artistry of human mastering engineers, it can help to streamline and optimize the process,

allowing for more efficient and effective music production (Birtchnell, 2018). AI for example enables some of the routine aspects of audio mastering to become easier and, in the future, even eliminated, including error correction and media formatting (Birtchnell, 2018).

In fact, some argue that AI can actually enhance the work of human producers by providing new tools and insights that can be used in the creative process (Britchnell, 2018). As AI continues to evolve, new job opportunities may arise in the development and maintenance of these technologies. Additionally, AI cannot replicate some of the unique skills and artistic judgment of a human producer or engineer, making it less threatening regarding job opportunities for humans in the future (Weng & Chen, 2020).

While AI is offering some benefits to the mastering process in music production, there are also potential negative sides that should be considered. One potential issue is the risk of overreliance and abundant use on AI-powered mastering software. While these tools can offer a more timesaving, faster and more cost-effective way to process audio, they may not always produce the same level of quality and nuance as a human mastering engineer (Birtchnell, 2018). This can lead to a homogenization of sound across different tracks and genres, with less variation and individuality in the final products (Micchi, Bigo, Giraud, Groult & Levé, 2021). On the other hand, this can also be seen as a benefit, because with the help of AI a song can become a coherent part of an album, and the album a uniform part of similar products on the market (Collins et al., 2021).

Another potential negative side of using AI in mastering is the risk of losing the human touch and creativity, as relying too much on AI can be potentially dangerous and can lead to lack of originality (Micchi et al., 2021). Therefore, it is important to strike a balance between using AI as a tool to enhance and streamline the mastering process and preserving the artistry and individuality of human creativity.

Another concern is the potential for bias and lack of diversity in the algorithms and data sets used by AI-powered mastering tools. If the algorithms and data sets are not diverse and inclusive, there is a risk that the resulting output may not represent a wide range of musical styles, cultural perspectives, and listening preferences (Collins et al., 2021).

Although AI-powered mastering platforms can help human audio engineers as tools while working, these programs are becoming increasingly advanced and can now perform many of the tasks traditionally performed by human audio engineers. This may lead to some displacement of human workers in the industry (Birtchnell, 2018). For example, some music producers may choose to use AI-powered mixing and mastering software instead of hiring a human audio engineer to do the work for them because it is faster and less costly.

Previous research on the importance of AI in music production mainly focuses on mastering. However, the mixing process is also typically done by a mixing engineer and therefore AI can definitely make some routine processes easier in mixing as well. Overall, while AI is offering some potential benefits to the mixing and especially mastering process in music production, it's important to be mindful of the potential negative sides and work towards finding a balance between using technology to enhance the process and preserving the creativity and artistry of human music production.

2.4 AI-powered mastering platforms

AI-powered mastering platform in this research refers to a computer-based tool that uses advanced AI algorithms to analyze and enhance the sound quality of music tracks. AI-powered mastering platforms automate the process of mastering by using machine learning techniques (Sterne & Razlogova, 2019). They are designed to be user-friendly and accessible to a wide range of users, from professional music producers to amateur musicians. To name a few, eMastered and LANDR are these kinds of AI-powered mastering platforms.

2.4.1 eMastered

eMastered is an AI-powered mastering platform that uses cutting edge technology to analyze and process audio files (eMastered, n.d., FAQ). It was launched in 2015 by AI experts and professionals working in music industry and since then it has become more popular year by year due to its various notable perks (eMastered, n.d., Front page). The user friendliness and easy access from anywhere in the world with internet connection has allowed musicians and music producers with different set of skills to adopt eMastered as their everyday tool to improve the quality of their sound and has helped them to finish their musical pieces with effective and satisfying results (eMastered, n.d.). In other words, it serves as a bridge that could have been hard to cross otherwise and narrows down the gap between music production’s final stages and publishing. eMastered can be

seen as tool that makes mastering faster and easier. For people who lack the skills in mastering, publication of a musical piece can be a distant dream due to the fact that mastering stage in music is so important regarding the overall sound of the final product. Therefore, it can be assumed that individuals from beginners to intermediates are probably going to benefit the most from AI-powered mastering platforms like eMastered because they often tend to work on music as solo project without a comprehensive network to rely on (eMastered, n.d., Blog).

eMastered utilizes advanced AI algorithms to enhance the sound of audio files. It analyzes the data of the audio files and makes adjustments to reach optimized quality of the sounds that meets the commercial music industry standards (eMastered, n.d., FAQ). The platform offers various advanced mastering options including the most common traditional mastering, custom mastering, and reference mastering (eMastered, n.d., FAQ). When choosing the reference mastering option, the user of the AI-powered mastering platform is provided with a reference track mastered by a professional audio engineer, making it easier to for example meet the genre specific standards when mastering own audio file (eMastered, n.d., Reference mastering). eMastered is able to detect the genre of the fed audio file and is capable of mastering that specific audio file according to the common themes in that genre (eMastered, n.d., Mastering). In eMastered there is also an option to customize the final sound of the songs by using more advanced settings such as adjusting the compression, stereo width, and the mastering intensity (eMastered, n.d.).

One of the main benefits of eMastered could be seen to be its speed, simplicity, and convenience. Users can upload their tracks to the online mastering platform and receive a final master of their song quickly in a matter of minutes, without the need for in-depth knowledge of audio engineering or mastering processes or a dedicated human mastering engineer (Sterne & Razlogova, 2019). This can save time and money, while also providing high-quality results that are comparable to those achieved through traditional mastering methods. In (Figure 1) there is an example of the differences between an unprocessed original audio file and the same audio file processed by eMastered.

Overall, E-mastered is an example of how AI is being used to enhance the music production process, offering musicians and producers an accessible and efficient way to automate tasks and improve their tracks' sound quality and overall quality of music production.

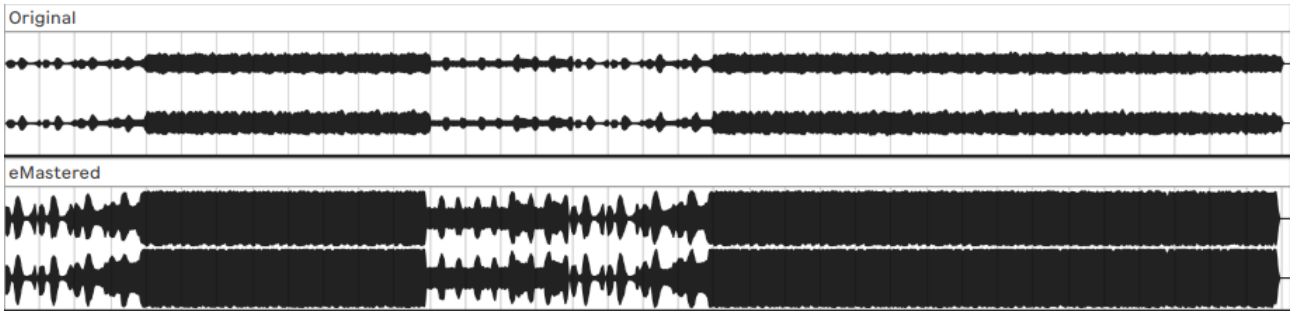

Figure 1. Audio file shown in Digital audio workstation (DAW) called “Ableton” before and after it is processed by AI-powered online mastering platform called “eMastered”. Source: researcher’s own.

2.4.2 LANDR

LANDR is another cloud-based music production and mastering platform that uses AI algorithms to provide musicians and producers with automated mastering services (Sterne & Razlogova, 2019). Based on the information in LANDR’s own website, the platform offers a variety of mastering options, including automated mastering, stem mastering, and custom mastering, and allows users to customize the final sound of their tracks using a range of settings.

LANDR's mastering service uses AI to analyze the sonic characteristics of a track and apply adjustments to the frequency response, dynamic range, and stereo width, among other parameters (Sterne & Razlogova, 2019). The result is a professionally mastered track that is optimized for distribution across various platforms, including streaming services and vinyl.

In addition to mastering, LANDR also provides a suite of music production tools that use AI to automate tasks such as mixing, sound design, and arrangement (Sterne & Razlogova, 2019). The platform's AI-powered tools can analyze and learn from a user's creative choices, allowing them to generate more personalized and polished results over time (LANDR, n.d., Master).

LANDR has been used by many notable musicians and producers in the music industry, and it has received positive reviews especially for its speed and convenience (Collins et al., 2021). In LANDR users can receive a mastered track back fast after the original audio file has gone through the analyzing and mastering process on the website, without the need for in-depth knowledge of audio engineering or mastering processes (Sterne & Razlogova, 2019).

Another benefit of LANDR is its accessibility. The service can be accessed from anywhere with an internet connection, making it a convenient option for musicians and producers who may not have access to traditional mastering services or equipment (Collins et al., 2021).

To sum it up, LANDR is another example of how AI is being used in the post-processes of music production to automate tasks and provide high-quality results at a lower cost and with greater accessibility. LANDR's automated mastering tools offer quick options for musicians and music producers on various different skill levels who are looking to advance the sound quality of their tracks.

3 Methodology

In this chapter the reader will find information about the research design including research approach, methods that were used to collect and analyze the data as well as procedures that were used to ensure the reliability and validity of this research and discussion about any ethical concerns or issues that should be considered.

3.1 Research approach

This research uses Qualitative data analysis to identify themes and patterns in the data that is being collected. The goal of qualitative data analysis is to develop an understanding of the factors that contribute to the phenomenon that is occurring (Lester, Cho, & Lochmiller, 2020). Through this analysis method, the researcher seeks to develop explanations and theories that help to explain why and how the phenomenon occurs (Lester et al., 2020). Qualitative data analysis is based on subjective interpretation of the data and therefore the results can be affected for example by researcher's own experiences and beliefs (Lester et al., 2020). To help minimize subjectivity, the researcher uses clear and well-defined research question and reflects his own personal biases and perspectives on how they may be influencing the data analysis process (Lester et al., 2020).

This qualitative research utilized content analysis that is a systematic approach to analyze and understand the content of any form of communication, such as interviews and written documents (Elo, Kääriäinen, Kanste, Pölkki, Utriainen & Kyngäs, 2014). More specifically this qualitative research utilized thematic analysis which is a specific type of content analysis that involves identifying, analyzing, and reporting patterns or themes within the data (Clarke & Braun, 2017). This

method involves the identification of patterns in the data and the development of themes through the systematic coding of data, followed by the interpretation of the meaning of those themes (Clarke & Braun, 2017). Thematic analysis can be used in qualitative research to analyze interview transcripts, focus group discussions, or other textual data (Clarke & Braun, 2017).

The research involves using cross-sectional research design. A cross-sectional research design is a type of research design that collects data from a sample of individuals at a specific point in time (Wang & Cheng, 2020). Interviews in this research are conducted at a specific point in time but they aim to gather insights on both the current phenomena and possible near future phenomena as well. In other words, some of the interviewee's answers also reflect their beliefs, opinions, or predictions about the future.

3.2 Data collection

The interviews in this research were conducted in a semi-structured manner. This means that instead of purely focusing on asking pre-set questions in a pre-set order and sticking to a strict script (like in a structured interview), in a semi-structured interview the interview situations are more flexible (Kallio, Pietilä, Johnson & Kangasniemi, 2016). It allows the interviewer to choose the order of the predetermined interview questions as well as allows the interviewer to follow up the answers of the interviewees with additional questions if needed (Kallio et al., 2016). This means that the interview situation allows more opportunities for discussion. In other words, semi-structured interview usually begins with a set of pre-determined questions, but the interviewer can ask open-ended questions to clarify or explore the topic further.

Data in this research was collected from semi-structured interviews that were conducted and aimed towards two individuals simultaneously who consider themselves as self-identified intermediate music producers and who have used modern technologies as tools to create, finish and publish music. The interviews were conducted in Finnish and therefore had to be translated to English regarding this research.

The interviews were conducted over the course of one day on the 18th of April in the researcher's home which was intended to serve as a place and as an environment that supports the anonymity

of the participants. The interview situations lasted a total of one hour and twenty-one minutes based on the length of the audio recording.

The interviewees were chosen from the researcher's close circle based on researcher's information about the fact that the chosen individuals have knowledge about music production on intermediate level. Based on the researcher's inquiry towards the individuals via phone-call and face to face conversation before arranging the interview situations the researcher decided that the participants will be suitable to give answers to the research topic and research question. The decision to conduct the interviews on intermediate music producers rather than on professional music producers or AI experts was made to respect the purpose of the research topic and to gather reliable data that speaks to the research's intended target group that the research question seeks to answer.

During the inquiries before the interviews both participants agreed on the fact that they would know each other's identity and the interview situations would be implemented simultaneously. Before the interviews, the researcher and the participants agreed to present no names before, during and after the research to other people outside of this research. Therefore, the interviewees in this research are being presented as anonymous to respect their privacy.

The interview questions were designed based on the individuals' intermediate traits regarding music production. The goal was to create a consistent order of interview questions that started from more general and broad questions related to AI and then narrowing down to more specific questions related to AI's impact on mixing and mastering, which are the post-processes of music production. The interview questions were asked alternately from the two interviewees each time a new question was presented to create diversity and to avoid possible following, imitation, or mimicry of the other individual's answers. The translated interview questions that were asked from the interviewees during the interviews are provided in the (Appendix 1).

In this research the researcher's own points of views, perspectives and observations were being used as a source of data to reflect the gained data from the interviews that were being conducted. To sum it up, sources of data in this research are the interviews and the researcher's observations.

Interviews' purpose in this research was to gain information from the individuals' personal experiences related to this topic. Therefore, researcher's personal experiences should not affect the results of this research in a negative way since the researcher also considers himself as an intermediate music producer as well and therefore it helps to analyze the obtained data from the interviews from similar point of view as the interviewees in question.

3.3 Data analysis

The researcher recorded the interviews with audio recording application on smartphone and transcribed the recorded audio files to written form on laptop. The interviews had to be translated from Finnish to English due to the nationality of the individuals. After the interviews were transcribed and written down, the researcher decided to preserve only the main content of the data from the audio files. In other words, all of the other so-called unnecessary sounds such as "uh", "hmm", "like" were left out of the written versions of the interviews, unless they were considered to have some significant meaning for the sentence. After this procedure was completed, the researcher then proceeded to review the interview questions and answers one by one from all of the participants in order to find similarities and differences that could then be later reflected in the results chapter to answer the research question. Because of the fact that the voices of the participants in the interviews could be recognizable by individuals who are not involved in this research, the researcher transferred the audio files from the smartphone that was used in the interview to a laptop to a secure folder with password access as a procedure to protect confidentiality and highlight data protection.

3.4 Verification of the results

Choosing the cross-sectional research design allows the researcher to collect data more efficiently and with a smaller sample size. By conducting a semi-structured interview, the researcher gains access to the flexibility with follow up questions and the freedom of not using a specific order of the questions, as well as enables the researcher to gain a deeper understanding of the topic due to the possibility of the interviewee answering and expressing themselves and their experiences or opinions more freely and therefore develop the discussion further related to the topic. This also increases the reliability and validity regarding this data collection method as the answers can be standardized but it still allows for the participant's unique perspectives to be captured.

Research topic and research question seeks to answer to the question about AI's relations in mixing and mastering with the focus on individuals that consider themselves as intermediate music producers. The research was conducted in a way that focuses on getting data specifically from two intermediate music producers who are using modern technologies as their tools in the post-process of music production. Although two individuals were interviewed simultaneously, the purpose was to obtain independent and high-quality answers. For this reason, the interviewer made the decision to ask the interview questions alternately from the interviewee number one and the interviewee number two each time a new question was presented so that the analyzed data would be as diverse and comprehensive as possible. This ensures that the data collection and data analysis methods used in this research are in contact with the research topic and tends to answer the research question in the correct manner.

There are already existing background theories indicating and suggesting that AI can have a significant impact on mixing and mastering in music production (Collins et al., 2021). This research seeks to compare already existing and more generic theories with the data gained from the intermediate music producers via interviews and then possibly complement and bring new insights to these already existing theories. It should be noted that in this research the conclusions and results regarding AI's impact on mixing and mastering at the intermediate level are derived from a sample size of only two intermediate music producers, and the goal is to richen the already existing theories that can be applied to a larger population of intermediate music producers, making the findings more generalizable to the target group in question. Therefore, the research results may not be valid if they were to be compared for example with the opinions and findings of a professional music producer or an AI expert regarding the same topic but would more likely apply if viewed from the perspective of an intermediate music producer.

Since the purpose of this research is to make observations, conclusions and provide insights into the phenomena specifically from the perspectives of intermediate producers regarding AI's impact on mixing and mastering at the intermediate level, it does not therefore invalidate the validity of the research results or objectives. Due to the small sample size in this research and the possibility that the intermediate music producers may not necessarily fully represent the entire population, this research may likely distort the results if they were to be compared with more generic theories and perspectives.

3.5 Ethical Issues

One ethical issue that has had to be considered in conducting this research is the anonymity of the study participants. The names of the interviewees are known to the participants of the interview situation including the interviewer and the two interviewees, but their identities have been kept confidential outside of the research. Anonymity should not be a problem in this study because the wishes of the interviewees and the opinions and decisions of both the interviewee and interviewers were taken into account before data collection, during data collection, and when reporting the results. To ensure that the research was conducted in a responsible and trustworthy manner that respects the interviewees confidentiality, the audio files from the interviews were kept in encrypted folders that only the researcher had access to.

There is a possibility that some aspects mentioned during data collection or data analysis have been translated or interpreted incorrectly from Finnish to English. However, the research has been conducted as responsibly as possible by devoting a lot of time to data collection and data analysis. However, in these kinds of situations full certainty cannot be given or promised but the researcher has tried his best to do so.

Although it has been mentioned in the research that the researcher also considers himself as an intermediate music producer and therefore using their own perspectives or bringing them up will not harm the research results in a negative way, it is still possible that the researcher has processed the data too much based on their own views or been too biased towards certain perspectives. To prevent this, the researcher has acknowledged this issue and the challenge of subjective perspectives in objectivity and has tried his best to reflect own points of views on already existing studies and literature related to the research topic to critically evaluate them.

4 Results

By conducting the interviews that were aimed towards two different intermediate music producers who were either working in the field of music or having music as a part of their lifestyle as a hobby and passion, the researcher sought to gain valuable information regarding the relationship between AI, mixing and mastering. In the beginning of the interviews, it came clear that one of the most common things when it comes to AI's relations in music production and more specifically

mixing and mastering was the fact that it seemed like it was hard for individuals who are not fully educated or professionals on the topic to even separate concrete tools that uses AI in the first place. But by asking more detailed questions related to this research's topic, it opened an opportunity for both the interviewer and interviewees to dive deeper into the research topic and talk about aspects and phenomena that could have been missed otherwise and not considered as an option.

Researcher asked various and multiple different questions from the interviewees that focused specifically on AI's current relations to mixing and mastering and how AI is being utilized in these processes. Overall, there was a very noticeable difference between the knowledge about AI's impact on mastering compared to AI's impact on mixing. In this research, the interviewees were able to answer questions related to mastering better compared to mixing related questions. Because the topic of AI and mastering provided a much more comprehensive amount of information in interviews compared to AI and mixing, the researcher decided to focus more on the AI's impact on mastering in order to make the interview more comprehensive for research purposes.

The discussions about AI's impact on mixing ended up being were very minimal in the interview situation, and based on the quality of the responses related to mixing the researcher decided that it would have been unnecessary to delve deeper into that topic because it quickly became apparent that the interviewees had significantly more concrete knowledge about AI's relations to mastering compared to AI's relations to mixing. Therefore, it made more sense for both the interviewees and the interviewer to focus more on mastering rather than mixing by discussing the topic of mastering in more depth.

The researcher attempted to return to questions related to AI and mixing in later stages of the interviews because it could have potentially sparked new thoughts about the topic, given that the discussions and knowledge related to AI and mastering were so much more comprehensive compared to AI and mixing. This decision was made based on the fact that it might have been possible that some previously unmentioned aspects and discussions about AI and mixing could have arisen by returning to AI and mixing after the in-depth discussions about AI and mastering which happened during the later stages of the interviews.

Unfortunately, nothing particularly significant about AI's impact on mixing emerged, and thus, the conclusion can be drawn that the effects of AI on mixing are not well-known or understood in intermediate music production, and concrete examples related to this topic cannot be distinguished or at least it's difficult for the individuals to do so to say the least. Of course, the lack of knowledge about AI's impact on mixing among intermediate music producers may also be influenced by the small sample size used in this research and it could be possibly corrected by introducing a larger sample size and redoing the research.

According to the interviews conducted in this research, AI and more specifically AI-powered mastering platforms such as eMastered and LANDR have been proven to significantly enhance a music producer's workflow in the final stages of their music production process, particularly if the individuals are on intermediate level. Interviewees stated that learning mastering or audio engineering skills by self-teaching or attending courses to learn those skills can be costly, incredibly time-consuming and requires extensive practice, effort, and repetition. The interviewees said that the possibility to use AI-powered mastering platforms as an alternative option to human audio engineers has allowed the individuals to master their songs more freely by uploading their audio files from home to online whenever they want to and getting them back quickly with satisfying results. Example of the audio file's upload window in eMastered can be seen in (Figure 2).

Figure 2. Demonstrates the window that is being showed before user uploads the desired file to start the mastering process. Source: researcher's own. (From eMastered.com, n.d.).

It turned out that the usage of AI-powered mastering platforms can help intermediate music producers to achieve radio-ready songs faster and cheaper compared to human audio engineers. The

AI's mastering process takes easily less than five minutes starting approximately from one minute. The individuals considered the final products mastered by AI as "ready for publishing" for example on music streaming services due to the high-quality and fast delivery. According to the interviewees, it can often take days to receive back a mastered version of the original song even from professional audio engineers and on top of that it can be expensive and a lot more costly when compared to AI-powered mastering platforms such as eMastered and LANDR. They also said that depending on how actively and often an individual uses these platforms naturally affects the overall price and efficiency ratio. A popular option for users in eMastered is to choose the yearly payment option which is currently over half times cheaper compared to the monthly fee. Therefore, if a user chooses the yearly payment method and uses the platform actively to master songs, it will most likely be cheaper than hiring a human audio engineer to work on individual songs each time. If an individual solely focuses working on their music as a solo project including every production aspect of a musical piece from start to finish including writing, producing, publishing, distributing, and mixing the almost finished product, it seems that they can greatly benefit from using AI-powered mastering platforms to finish their musical projects faster and cheaper. Example of the analyze window of the audio file in eMastered can be seen in (Figure 3).

Figure 3. Demonstrates how eMastered quickly analyzes and adjusts the audio file that is being selected for mastering. The process to receive the final product usually takes between 1-3 minutes. Source: researcher's own. (From eMastered.com, n.d.).

As humans who are working on a professional level in the field of music has set certain benchmarks and presuppositions for the AI-powered mastering platforms on how a song should sound

like after it has been mastered by it, it according to interviews can greatly reduce the music producer's threshold to publish their music by using AI-powered mastering platforms. The interviewees said that they feel like they in a way get a "seal of approval" and "sense of security" from the AI-powered mastering platform that it is actually following the criteria of streaming service quality of a finished product during the mastering process because the criteria of high-quality were set by professional humans who developed these AI-powered mastering platforms in the first place.

As mentioned previously in this research, mastering is the final touch and post-process on a song or an album before it is being distributed forward to different formats such as CD, Vinyl or Online streaming platforms. For intermediate music producers, it is important that the musical piece that the individuals have been working on and putting the time and effort in is considered as professional and high-quality sounding as possible at the time when it is being released for example on music streaming platforms such as Spotify. According to the data collected from the interviews, since these AI-powered mastering platforms use mastering algorithms that it has learned from various professionals in the field of mixing and mastering, it boosts up the confidence of intermediate producers to get their product ready for distribution because they can so to say "automatically assume" that the criteria that the AI uses and the manner and way in which the AI is mastering the song is considered as a high-quality radio ready outcome.

In this research when looking back at the analyzed and collected data, it was typical for intermediate music producers to focus on producing specific genres of music. What this means is that one of the producers would focus mainly solely for example only on hip hop or rap beats, and the other producer would focus more on electronic dance music or in short "EDM" such as house or techno. When the researcher asked for more detailed information about the interviewees observations when it comes to the end results of their finished and mastered songs while using AI-powered mastering platforms, it turned out that especially when making an album that consists of similar songs regarding the musical genre, the producers were genuinely happy and satisfied about the end results and how the album sounds as a whole and as a united musical piece.

When making an album, it is typical that regardless of the genres that the different songs are providing the album with, the mastering process plays a big role in the ends result on how the album sounds. Mastering can be done in various different ways depending on who or what is doing

the mastering process, how is the mastering process being done, what tools are being used, and what are the focusing points on different genres. Related to this same topic, the individual music producers who claimed that AI-powered mastering platforms have helped them while focusing on working on an album brought up that the biggest and most noticeable observation that they could think of besides the cost-effectiveness and timesaving was the AI's capability to keep a consistent theme throughout the album as a whole when they were focusing on a specific genre. They mentioned that when listening to the songs one after the other inside of an album that was mastered by AI, they could recognize the similarities in the AI's mastering styles between separate songs and found that they fit together and blend in nicely.

When asked about the interviewee's opinions about different types of albums that would focus on multiple genres instead of one genre, the interviewees were unsure and were not able to answer properly how that would affect the AI's capabilities to provide a coherent outcome since neither of the two interviewees hadn't tried to make an album that includes multiple genres. One of the interviewees stated that it could possibly have some effects on how the album sounds as a whole. The interviewee said that the reason for this phenomenon could be the fact that that the way in which different genres are being mastered even by human audio engineers varies a lot and certain genres focus on certain instruments and elements more than other genres. Interviewee then added that this could also be connected to the mastering process done by AI and could affect the styles and methods in which mastering processes are being executed and therefore it could affect the end product in numerous different ways, including negative effects.

This led to another short conversation where the interviewees discussed about other possible negative effects AI and one of the interviewees mentioned that for those individuals who are working on the mastering side of a musical piece, job loss could be a possibility especially in the future since AI is constantly advancing. This conversation brough up that since AI is becoming more and more unrecognizable from human, it can for example cause lack of creativity and lack of human touch regarding the future of music production. The other interviewee then added that AI will most likely shape and transform other fields of music industry as well by bring new downsides on top of new positive effects to our everyday life in a way that has never been seen before or thought about before.

The interviewees stated that individuals who decide to use these AI-powered mastering platforms to master a song can for example choose the genre specific mastering style and approach for their song in question on the AI-powered mastering platform before starting the mastering process. In this case the AI will use algorithms that fits the familiar themes of certain types of songs and genres to generate a more accurate and more desired outcome for the user.

On top of that according to the interviews, especially over the past few years these AI-powered mastering platforms have released and are now offering more advanced options with multiple choices to modify and fine tune the mastering options and preferences, therefore making the desired outcome even more accurate. Example of some of the advanced options can be seen in (Figure 4). This includes for example the option for the user to choose between 2 different mastered versions of that mastered audio file. Example of this can be seen in (Figure 5).

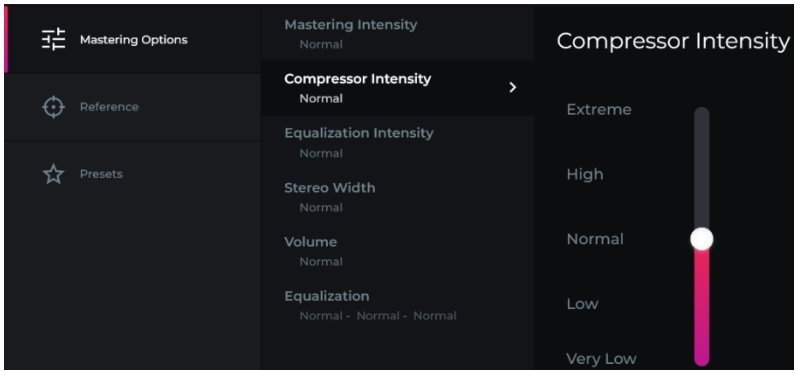

Figure 4. Demonstrates the few different mastering options among many that eMastered has to offer. Source: researcher's own. (From eMastered.com, n.d.).

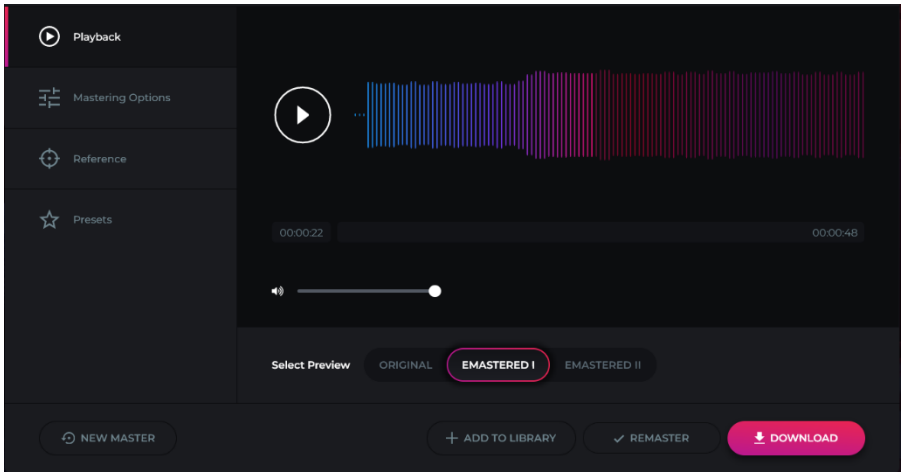

Figure 5. Example of the window after the mastering process is done. Users can choose between two mastered versions and have the option to remaster if desired or change the preferences and adjust the final product. Source: researcher's own. (From eMastered.com, n.d.).

During the interviews, the interviewees also brough up a concept of reference mastering on certain AI-powered mastering platforms, such as eMastered. The users of AI-powered mastering platform can now choose reference mastering as an option as well. Reference mastering is a feature in eMastered that allows the users to compare their mastered audio files to professionally mastered reference tracks. The reference track used by eMastered is chosen based on the genre of the audio file that the user uploads and the goal is to provide a reference track that is similar in style and quality to the user's own audio file. According to interviews, this comparison helps the user to evaluate the quality of the audio and make any necessary adjustments to the mastering settings to achieve a desired outcome. As the reference track provides an objective standard and consistent benchmarks towards specific genres, it can help the individuals to make informed decisions about the final product and helps the user to learn about mastering in the process as well while doing so. Example of the official explanation of reference mastering by eMastered can be seen in (Figure 6).

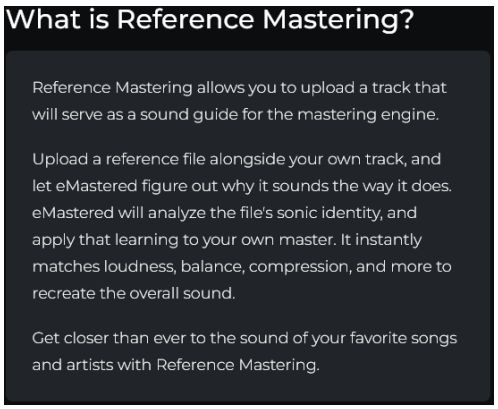

Figure 6. Explanation of reference mastering from the eMastered website. Source: researcher's own. (From eMastered.com, n.d.).

5 Discussion

The discussion chapter is divided into five subchapters, each serving a distinct purpose. The first subchapter focuses on addressing the research question by presenting conclusions and observations related to the research objectives and research topic. The second subchapter is called practical contributions and it presents the key findings of the research that could be useful in a practical setting. The third subchapter is assessments of results in the light of literature, and it talks about the observations that were made during this research and reflects them back to already existing literature and knowledge related to the research topic. Limitations of the research subchapter identifies and discusses any potential limitations or distortions that may have affected the research. Finally, the researcher provides recommendations for future research, highlighting areas for further development based on data gaps or other observations made during the research.

5.1 Answers to the research question

AI is currently developing at incredibly fast rates due to it learning more advanced and updated algorithms with massive amounts of data it is being fed with. AI is mostly considered as very useful tool in post-processes of music and it should be important to keep in mind that as tools they can benefit and give new perspectives and insights (for example different techniques), but when overly used, it can cause homogeneity, lack of human nuance and inconsistencies in the sound of finished products such as a specific song or an album, especially in the future. This can be especially true when releasing an album.

The way the songs are being mastered by these AI-powered mastering platforms is dependent on the data and algorithms that it's fed with (Collins et al., 2021). Different genres of music have very different focus points when it comes to mastering and mixing a song. Dance music tends to focus on strong drums and notable bass lines and therefore it is important that these themes emerge well on the final product whereas pop and rock songs tend to use more flat sound design so that every detail can be heard in a more balanced way.

An album is often seen as a collection of songs that share common themes, styles, and genres among them. On the other hand, an album can be also composed of songs that do not share any similarities with each other, making it the complete opposite to the previously mentioned style of

an album that shares common themes. That being said, on top of the styles and genres of songs in an album, themes can depend on the multiple different aspects that are related to mixing and mastering processes of songs as well and therefore the outcome can be greatly affected by it. What this means is that even though the genre might be different between two songs in an album, the way how the album sounds as a whole is heavily dependent on the mastering procedures that are being used as well as it is the final touch in post-processing before a song or an album is being released.

If an AI-powered mastering platform is used to combine an album that consists of various different genres, it seems AI tends to focus more on mastering specific songs and specific genres inside of an album in a similar way, rather than mastering the album as a whole to keep the certain important main themes well and alive that ties the songs together that are within that same album. In other words, AI masters the individual songs based on the genre specific themes that the songs are categorized to by default algorithms used by AI, rather than focusing on the fact that the album should sound as coherent and united as possible as a whole. “Hence it is crucial for the sound production to fit with established genres and comply with summing standards in the original upload, otherwise unpredictable results could eventuate” (Birtchnell, 2018).

This is easier to understand if thinking about a scenario where two different professional human audio engineers are working on the same album’s mastering process and the first audio engineer is mastering the first 5 songs and the second audio engineer is mastering rest of the songs in the album. The results of the finished songs after the mastering processes that are done by two different audio engineers can be easily recognizable and therefore it can affect the end result of the album in an unintended or unwanted manner. Same applies to a situation where an AI is working on a complete album and doing the mastering process. It can harm the final product in a similar negative way.

Of course, there are exceptions where audio engineers have their unique combinations of equipment (Birtchnell, 2018) and skills which makes them recognizable from others and therefore an artist might want to do exactly the opposite and for example highlight and emphasize the different styles and methods of audio engineers in a positive way to give the credits to the individuals who

are doing the final touches to the album or the songs. This means that the gaps in the themes are not always considered as a negative thing and are sometimes left there intentionally.

Given the small sample size in this research, music producers that considered themselves as intermediates in the field of music production thought that the mastering tools which are powered by AI in music production have helped these individuals tremendously especially in the mastering processes to achieve a desired outcome. According to the interviewees in the research, radio-ready songs can be easily achieved in matter of minutes when using AI-powered mastering platforms after the individuals have considered the musical piece finished when it comes to mixing and volume levels and doing everything they can to make the musical piece sound as professional as possible in the capabilities of their own personal skills.

It seems that while AI in mixing and mastering can have various positive effects and outcomes for intermediate music producers, there are concepts to consider especially regarding the future of AI's impact on mixing and mastering. Individuals automatically assuming that AI-powered mastering platforms are capable of providing same or at least similar level of quality in mixing and mastering as professionally educated human audio engineers might not sound like a big problem now, but the fact that as AI gets smarter and smarter, it might become dangerously difficult for people to for example critically evaluate differences between AI and human, such as quality and other important concepts. These could cause problems related to for example copyright issues regarding future.

Although AI-powered mastering platforms have developed faster over the few years and is constantly advancing by learning from the massive amounts of data given to it because larger population uses it more than before, it still has its own flaws. It can recognize and master the song according to certain themes and genres given to it, but it cannot be fed with more advanced individual commands yet to replicate or model creativity and that's where the professional human audio engineers in the mastering field comes in handy.

Besides AI, mixing and mastering can be executed in various ways by professional audio engineers, and it is still a creative process, so it is debatable whether AI will affect for example the biggest artists, audio engineers and producers in the future or not, but it for sure has been affecting and will

affect the post-processing in intermediate music production by making it faster, cheaper, and more convenient.

5.2 Practical contributions

The information from this research reinforces previous studies and knowledge regarding the mainly positive implications of AI in music production and expands the knowledge to also cover intermediate music producers and intermediate music production, as well as AI's impact on mastering process.

Music producers of various skill levels can benefit from the research findings. This research can benefit especially intermediate music producers but also beginners aspiring to reach that level, who are exploring the field of music production and considering the best possible ways to achieve their goals.

Individuals who are lacking skills in mastering but are overall semi-skilled in other areas of music production can benefit from this research because AI-powered mastering platforms seem to expedite the music publishing process. As reported by participants, there are at least two very notable, useful and popular AI-powered mastering platforms, eMastered and LANDR, that even beginner music producers can utilize to enhance the efficiency of their music production.

The information obtained from the study reinforces the benefits of AI in beginner music production as well, as modern technology makes music production stages easier and reduces the threshold for starting or learning music production at various stages. Based on the research, it can be concluded that blindly trusting in AI is not advisable, but it can be useful as a helpful tool.

5.3 Assessment of results in the light of literature

In this research, it turned out that more advanced technologies such as AI-powered mastering platforms have made mastering process more straightforward and therefore it is lowering the intermediate music producer's threshold to publish music. These similar observations are also mentioned in already existing literature (Weng & Chen, 2020), and therefore this research's results are aligned with some of the earlier literature regarding the topic.

Also, the interviewees emphasized on the fact that AI-powered platforms are greatly reducing the amount of effort and time that they need to spend on mastering processes if it were compared with for example human audio engineers doing the work. This is in line with previous knowledge that this kind of technology makes the post-processes such as mastering easier (Birtchnell, 2018).

In addition, it is for example known that mastering with AI can lead to a homogenization of sound across different tracks and genres, with less variation and individuality in the final products (Micchi et al. 2021). This also came up in the answers of the interviewees as they stated that AI might reduce the amount of human touch in the music production and therefore affect creativity.

In general, previous studies have found that AI has various positive effects, especially in mastering and the responses from the interviews were in line with this information. In addition, previous research has acknowledged the risks of the increased importance of AI and the interviewees also brought up the negative or possibly negative aspects of AI's impact on mixing and mastering.

5.4 Limitations of the research

As this research was being conducted by using mostly cross-sectional research design with small sample size of two individuals, it may not provide a comprehensive understanding of the relationships between variables over time. Using mostly a cross-sectional research design in an interview can act as a limitation and affect the depth and scope of the research as well as limit the data and research findings. It may also affect and distort the more general understanding of the research topic itself as the participants were intermediate music producers. Therefore, cross-sectional research design can affect and limit the validity and reliability of the research findings, as the results may not be cross-checked with other data sources or perspectives. Because of this fact, the researcher needed to carefully consider the research question and objectives and select appropriate research methods and approaches to achieve the best possible understanding of the research topic itself.

Although there are multiple positive effects in conducting semi-structured interviews, it may result in subjectivity, as the researcher may interpret the data in a particular way or may not ask certain questions that are important to the study. Another thing could be that interviewees may not pro-

vide truthful or accurate responses due to social desirability bias, or they may not have the necessary knowledge or expertise to answer certain questions. And lastly, since semi-structured interviews are often conducted on a small sample size, the data collected may not be generalizable to the larger population.

The results acquired from this research could be hard to generalize to more general situation that takes into account bigger sample size that would include for example professionals and people who have worked around these topics and relations between AI and music for years, because the answers could potentially be totally different and therefore would not align with the results acquired from this specific research.

Due to the interviewee's little knowledge about mixing, the research was not able to answer the mixing aspect comprehensively enough regarding AI's impact on mixing. Therefore, researching the topic of AI's impact purely on mixing in intermediate music production could give valuable information about the phenomena that was not properly answered during the research.

5.5 Recommendations for future research

Overall, data collected from small sample size of individuals can affect the results and cause them to not be generalizable to larger population. Researching the same topic of AI's impact on mixing and mastering or AI's impact purely on mixing with larger sample size could lead to more accurate and better results regarding the phenomena.

Conducting same or similar research with a larger sample size and a diverse group of individuals through interviews with professional music producers instead of two individuals who consider themselves as intermediate music producers could give valuable insights and perspectives about AI's impact on mixing and mastering. This approach would contrast the differences between professionals and self-identified intermediates as a source of data and therefore would help to draw, specify, or generalize certain theories, conclusions, and differences between these two groups. This information could then be used to further develop ideas and phenomena.

In this research the main focus was to gain information on the AI's relations to mixing and mastering in music production regarding intermediate music producers. However, during the interviews

with one of the two individuals, it turned out that AI plays a big role also in the occupation of a DJ. This insight was gained from the fact that this particular interviewee was a professional DJ as well besides the passion towards music production. Therefore, it could be interesting to see future research regarding similar topic related to AI's effects from DJ's point of view and perspective as well.

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Appendices

Appendix 1. Interview questions

Question 1. You consider yourself as self-identified intermediate music producer. How much time do you spend on music approximately?

Question 2. In what ways do you think artificial intelligence has affected music production?

Question 3. In what ways do you feel that artificial intelligence has affected the mixing and mastering processes of music production?

Question 4. Can you specify some particular advantages or disadvantages related to this topic from your own perspective or from a general perspective?

Question 5. Can you name or specify some of the tools that are powered by AI?