

The Relationship Between Musical Intelligence and Critical Thinking Problem-Solving Skill in Undergraduates

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To Link this Article: <http://dx.doi.org/10.6007/IJARPED/v12-i2/17688>

DOI:10.6007/IJARPED/v12-i2/17688

Published Online: 18 June 2023

Abstract

Educators must be aware of effective methods for helping musically intelligence students develop their critical-thinking and problem-solving abilities. The purpose of study is to investigate the relationship between musical intelligence and critical thinking problem-solving skill. Quantitatively survey method was employed among 142 samples that were drawn randomly from a population of 240 students, enrolled in September semester 2022. The instruments were adapted from MyMICA (Multiple Intelligences Checklist for Adults) by Rahayah (2008) and soft skill for higher learners by (Kamaruddin, 2010). SPSS (Statistical Packaged for the Social Sciences) 28.0 version was used to analyze data. Result showed musical intelligence mean for male (23.5) is higher than female (21.6), mean of critical thinking problem-solving skills of male students (29.3) is higher than female (27.7), no significant difference of musical intelligence and critical thinking problem-solving skills across gender. There was a low positive correlation between two variables, $r(1.0) = .376$. Musical intelligence predicts 13.5% of the variance $r = .135$, $df(137) = 22.60$. Musical intelligence had the least impact on critical thinking skill. Contemporary teaching models to teach musical intelligence learners should be realized optimally through a constructivist approach and a learner-centered that require social interaction, cooperative, etc. It is critical for instructors to design their instructional strategies so that musical intelligence learners can improve their critical thinking problem-solving skills. Therefore, in future research, it would be recommended to study in detail the relationship between musical intelligence and the enhancement of other cognitive skills such as evaluating, mathematical, reasoning, scientific and practical problems.

Keywords: Critical Thinking, Problem-Solving Skill, Soft Skills, Musical Intelligence, Multiple Intelligence

Introduction

Musical Intelligence

Musical intelligence and critical thinking are two distinct cognitive abilities that can complement each other in various ways. Armstrong (2009) stated musical intelligence is the capacity to recognize, classify, transform, and express sounds and musical forms which enables individuals to create, communicate, and comprehend meaning using sound. This intelligence includes an awareness of the rhythms, melodies, and tones in music. Meanwhile Howard Gardner (1983) explained musical intelligence is one of nine multiple intelligences referring to the ability to easily produce and understand rhythm, melody, tempo, and rhythm. A musically intelligent person can understand, communicate, and produce sounds. Musicians, singers, and other artists, among others, exhibit this advantage. They are very sensitive to rhythm, song, and melody, can play and sing, enjoy music, and are at ease. It is the ability to create and appreciate rhythm, pitch, and timbre, as well as the appreciation of various forms of musical expressiveness (Hatch, 1997).

Gardner also asserted that intelligence is a combination of nine distinct types of intelligence, and that people with musical intelligence tend to think in terms of patterns (Frothingam, 2022). It is concerned with an individual's ability to perform, compose, and appreciate music and musical patterns. People who excel at this intelligence are usually able to use rhythms and patterns to help them learn. It is not surprising that Gardner considers musicians, composers, band directors, disc jockeys, and music critics to have high musical intelligence (Kelly, 2019).

Critical Thinking and Problem-Solving Skills

Critical thinking is central to John Dewey (Letseka and Zireva, 2015). John Dewey was a prominent American philosopher, psychologist, and educational reformer who made significant contributions to the field of critical thinking. Dewey emphasized the importance of critical thinking as a fundamental aspect of education and democracy. According to Dewey, critical thinking involves problem-solving and inquiry-based learning. He advocated for an educational approach that encourages students to engage with real-world problems and inquiries, promoting their abilities to analyze, evaluate, and generate creative solutions (Main, 2023). John Dewey pointing out that any subject taught at education institution can promote critical thinking if teachers/lectures base their instruction on challenges and issues presented for investigation and encouraging reflection (Kokkidoa, 2013).

There are five key opinions and ideas related to critical thinking expressed by John Dewey, 1. Reflective Thinking: Dewey emphasized the significance of reflective thinking, which involves active, careful, and thoughtful consideration of ideas and experiences. He believed that education should foster reflective thinking to develop critical thinking skills, 2. Problem-Solving and Inquiry: According to Dewey, critical thinking involves problem-solving and inquiry-based learning. He advocated for an educational approach that encourages students to engage with real-world problems and inquiries, promoting their abilities to analyze, evaluate, and generate creative solutions, 3. Experience-Based Learning: Dewey argued that learning should be based on concrete experiences rather than abstract concepts. He believed that critical thinking is best developed through active engagement with real-life situations, enabling learners to apply their knowledge and skills to solve problems in practical contexts, 4. Democracy and Critical Thinking: Dewey connected critical thinking to democratic citizenship. He argued that critical thinking is vital for individuals to participate fully in democratic societies, enabling them to question assumptions, evaluate evidence, and make

informed decisions, 5. Growth and Development: Dewey viewed critical thinking as a process that fosters personal growth and development. He believed that education should focus on cultivating students' abilities to think critically and adapt to new situations, equipping them to navigate an ever-changing world (Letseka & Zireva 2013).

Critical thinking and problem-solving skills are the capacities to recognize and evaluate issues in difficult and ambiguous circumstances as well as to support conclusions (Afifah & Nurbarirah, 2017). The ability to possess these skills will enhance thinking abilities like analyzing, explaining, and coming up with new solutions (Herrity, 2022). Critical thinking and problem-solving skills are defined by the Ministry of Higher Education (KPT, 2006) as the capacity to think critically, creatively, innovatively, and analytically as well as the capacity to apply understanding and knowledge to new and varied problems. It involves the capacity to assess an idea through characterizing, gathering, and classifying, contrasting, organizing, analyzing, synthesizing, evaluating, and drawing conclusions.

Furthermore, building competencies has become a major topic for many educators and research. These abilities can be developed through high-level thinking strategies involving critical and creative thinking. Creativity is the ability to generate new and original ideas, either from one's own ideas or by combining ideas from other people. These two critical and creative skills allow a student to solve learning problems as well as more complex problems. Problem solving is the process of overcoming obstacles to find solutions to problems (KPT, 2006). Turan et al (2019) posited that critical thinking and problem-solving skills encompass the ability to identify and analyze complex and uncertain problems, as well as make sound judgments. Conversely, Alsaleh (2020) defines these skills as the ability to develop and enhance cognitive abilities, such as explanation and analysis. Gafour and Gafour (2020) stated that critical thinking and problem-solving skills involve the capacity to generate innovative ideas and solutions and think outside the box. Similarly, Samarji (2014) views these skills as the ability to make decisions based on credible evidence, while Papathanasiou et al (2014) describe them as the capacity to persist and concentrate deeply on assigned tasks.

In today's educational world, learning to use mathematical intelligence to generate critical thinking intelligence does not provide opportunities for students who lack other intelligences such as musical, kinesthetic, visual, and others. To investigate further this issue, it is important to raise some questions. How are these students supposed to improve their critical thinking abilities? Is it true that people with musical intelligence cannot develop critical thinking abilities? Do all musical abilities compel students to develop problem-solving abilities, creativity, critical thinking abilities, or dispositions? Do all music lessons encourage critical thinking? It is necessary to explore the association between music and the enhancement of cognitive abilities, behaviors, and problem-solving skills. Topuglu (2013) suggested various ways to develop individuals' critical thinking skills. One method suggested by researchers is music education. However, some researchers claim that critical thinking skills are a specific domain. From this point of view, music abilities cannot help individuals to transfer critical thinking and problem-solving skills.

Multiple Intelligence

Howard Gardner (1983) revised the concept of intelligence, bringing it into a new era of debate and understanding. He believed that each person possesses at least eight intelligences or mental abilities, each of which exists independently, namely, language-linguistic intelligence, logical-mathematical intelligence, visual- spatial intelligence, bodily-kinesthetic

intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, and natural intelligence. All these intelligences exist in every human being, though their strengths vary. He added spiritual intelligence to the list of multiple intelligences bringing the total number of entities to nine per person. He had not, however, recognized the entity's existence until now.

Musical intelligence is also known as a psychological trait that everyone possesses and should be valued, and it is comparable to mathematical and linguistic intelligence, that has traditionally been widely valued (Campbell et al., 1996). Everyone is unique, the approach and treatment should be tailored to everyone "uniqueness". He emphasizes the approach that learning with this theory is not like ordinary or traditional learning. It's a type of mentoring. The process of mentorship is intricate, requiring mentors to consider the mentee's diverse levels and undertakings. Considering the multiple intelligence theory, mentors play a role beyond that of mere educators. They are not just counsellors but also evaluators, role models, and close friends. According to Linder (2020) the process is known as individualization in learning, individualized instruction, or self-learning. The theory can be used as an alternative to increase the added value of graduates by recognizing one's own potential and intelligence, as well as progress toward recognizing skills that can be developed as well as specific tendencies and talents in the career field.

Previous research has found that knowledge of self-intelligence can increase knowledge of self-potential and influence certain career skills, as well as help people choose a career that matches their strengths (Davis et al., 2011). The musical intelligence used as the focus of this study will be highlighted in the statement of problems to see how it contributes to critical thinking and problem-solving abilities.

Problem Statement

Ministry of Higher Education (MOHE) accentuated critical thinking and problem-solving skill is an important agenda in Malaysian education today, as part of the Malaysian Education Development Plan (PPPM) 2013- 2025 implementation (Ministry of Higher Education, 2013). Teaching students with critical thinking skills has also become a global concern in higher education. Critical thinking skill is one of the seven skills that students must develop during their tertiary education in Malaysia, (Afifah & Nurbarirah, 2017). Critical and creative thinking abilities are required for success in the twenty-first century (Perdana et al., 2019).

Previous studies indicated that there are deficiencies in thinking patterns and skills among higher education students although many strategies had been applied to generate skills either by embedded program or through stand-alone subject. Ilhami et al (2018) found that public Malaysian university students possess better problem-solving skills than their private university counterparts. It has also been reported that Malaysian university students lack soft skills, specifically problem solving and communication abilities (Zaliza & Safarin, 2014). Afifah & Nurbarirah (2017) on their observation study on classroom- based activities being conducted found that the critical thinking level of students in Diploma of Office Management in UITM was at a low or moderate level. This is consistent with the findings of Lee et al. (2019), who conducted a study to determine the level of critical thinking and problem-solving skills among engineering undergraduate students at Tun Hussein Onn University and discovered that students' critical thinking and problem-solving skills were moderate.

Therefore, it is necessary to develop educational policies and use strategies and means

to enhance thinking skills especially among university students. Many studies have indicated the best educational methods that contribute to the development of thinking patterns among students and the application of multiple intelligence in the classroom. The need to build the educational process around the theory of multiple intelligences was highlighted by (Yamin, (2013). Hence, Howard Gardner's theory on multiple intelligence is an excellent framework as guidance for developing students' critical thinking. Al- Khuzai and Al-Amrani's (2013) study suggests that employing learning strategies grounded in the multiple intelligence theory in the classroom setting can foster the development of students' thinking skills and patterns. This approach enables students to make informed decisions and solve problems, thus addressing their educational needs and acquiring life skills. By doing so, students can gain new experiences and keep pace with the ever-changing wheel of development.

So, the study tries to seek the relationship of whether musical intelligence can affect critical thinking and problem-solving skill. Logical-mathematical intelligence is often referred to as "scientific thinking". When compared to other intelligences, these two are often thought to be capable of producing critical thinking and problem-solving skills. Learning that focuses on mathematical logical intelligence only causes students who lack this intelligence, which is the focus of this study, to be unable to generate critical thinking and problem-solving skills. However, some researchers believe that musical intelligence should be considered a talent rather than an intelligence. They argue that musical intelligence is a talent because it does not have to change to meet life's demands. Gardner himself asserted that musical intelligence was concurrent with linguistic ability (Kelly, 2021).

Music in modern times is a popular culture in the twenty-first century. People nowadays are constantly exposed to and influenced by popular culture as well as students. They share values and practices that can be seen in the movies and shows we watch, in the art, comics, and novels they read, and in the toys and video games they play. Popular culture is made up of a diverse set of widely accepted elements that encompass the most immediate and current aspects of their lives. These traits are frequently subject to rapid change, especially in a highly modern age where ubiquitous media brings people and education institutions closer together. Songs, for example, have a lot of power. They could comfort, calm, inspire, and educate people. Songs have always served as a mirror to the world, with the ability to change society (Eonmusic, 2021).

Educational institutions are under pressure to help students develop their skills and competencies to meet the demands of the twenty-first century in the current global environment that places a strong emphasis on music culture. The curriculum should be modified to accommodate and achieve this goal. Mustikawati & Astuti (2021) suggested that music is the one of the potential subjects to develop 21st century skills by accomplishing effective interdisciplinary music study base learning to develop critical thinking. How might musical intelligence contribute to the development of critical thinking and problem-solving skills? Is there a correlation between musical intelligence and the acquisition of critical thinking abilities? Alternatively, could musical intelligence generate critical thinking? Conventional educational notions suggest that strong mathematical intelligence and skills are the primary tools for solving problems in daily life, with less emphasis on other forms of intelligence like musical intelligence, kinesthetic, visual spatial, etc. Previous research has revealed the potential limitations or challenges that musical intelligence learners face, even after they have received musical training to develop these skills such as study by Schlaug (2015) who explored musical in relation to other cognitive skills found that it may not directly translate to broader cognitive skills like critical thinking and problem-solving.

Odena & Welch (2013) conducted a study on musical training to examine the transfer of musical skills to other domains. They found that while musical training can enhance specific musical abilities, it may not necessarily lead to significant improvements in general cognitive skills, including critical thinking and problem-solving. Winner and Cooper (2000) explored the relationship between musical intelligence and other cognitive abilities found that while musically intelligent individuals may excel in certain musical tasks, they do not necessarily exhibit superior problem-solving skills or critical thinking abilities outside of the musical domain. These studies highlight the importance of considering the specific limitations and challenges faced by musical intelligence learners in developing critical thinking and problem-solving skills. While musical intelligence can contribute to certain cognitive abilities, the transferability of these skills to broader domains of thinking and problem-solving may vary. Consequently, yet researchers in this study are keen to explore and gain a better understanding of whether musical intelligence has an impact on critical thinking and problem-solving skills among undergraduates' students in private university in this country. It is essential to note that individual differences, the specific methods used in the studies, and the context in which musical intelligence is assessed can impact the results. Further research is needed to gain a more comprehensive understanding of the relationship between musical intelligence and the development of critical thinking and problem-solving skills in learners.

Literature Review

Xu's (2020) research on self-perceived multiple intelligences among Chinese EFL students revealed a high level of self-reported musical intelligence preference among both male and female HIU students. At a private university in northeast Mexico et al (2022) investigate how gender affects multiple intelligences, revealed that that there was no discernible gender difference in musical intelligence. Trevino et al (2020) examined the differences in multiple intelligences in elementary school children in Mexico and discovered that the students' mean averages in musical and seven other categories of multiple intelligences were similar in both genders. However, study by Perdana et al (2019) indicated female students had superior critical thinking abilities to male students, male students had superior creative thinking abilities.

Previous research has demonstrated a connection between musical intelligence and critical thinking patterns, which cannot be disregarded by researchers and psychologists. Musical intelligence plays a role in the development of critical thinking patterns. According to Frothingam (2022), individuals with high musical intelligence are inclined towards thinking abstractly in the form of music. Hickey (2001) investigated the impact of music instruction on the development of critical thinking skills in middle school students. The study found that students who received music instruction demonstrated higher levels of critical thinking compared to those who did not receive such instruction. Soleimannifar et al (2016) investigated the correlation between intelligence quotient (IQ) and musical ability in both hearing-impaired and normal hearing children in their research paper. The study found a significant positive correlation between IQ and musical scores in the control and experimental groups.

Children's research can also be seen in Rabinowitch & Knafo-Noam's (2015) investigation into the connection between musical aptitude, empathy, and creative thinking, found that musical intelligence positively correlated with creative problem-solving skills, suggesting that musical abilities may contribute to broader cognitive skills involved in critical thinking and

problem-solving. Similarly, Schellenberg (2004) discovered in his study of 6-year-old children that those who received keyboard training showed greater improvements in spatial-temporal skills, which are related to critical thinking and problem-solving abilities. This study suggested that musical training could enhance cognitive abilities.

In the meantime, Childhood music education has a lasting impact on intelligence and cognitive function. Criscuolou et al (2019) conducted a study on musicians and found that expert musicians had higher intelligence and executive function compared to non-musicians. The study also revealed a positive correlation between the duration of musical practice and cognitive performance. Musical intelligence is also influenced by cognitive ability. A recent study by Eric (2022) discovered a link between intelligence and music without lyrics. He discovered that intelligence predicts preference for instrumental music but not for vocal-instrumental music study among 467 Croatian high school students. Higher intelligence has been linked to the ability to compose music and a greater appreciation for patterns.

Music offers numerous opportunities for investigation like self-creativity, self-skills, self-expression, discipline, and satisfaction in overcoming life's challenges provide students with a path to success as well as a learning strategy that can be used in a variety of settings (Wan, 2022). According to Ming et al. (2012), there is a strong correlation between multiple intelligences and critical thinking abilities, and musical intelligence is strongly correlated with verbal linguistic and naturalist intelligence but not the mathematical intelligence, which related to critical thinking and problem-solving ability. It's important to note that these studies provide some evidence for a relationship between musical intelligence and critical thinking/problem-solving skills. However, individual differences, sample characteristics, and other factors can influence the results. Therefore, further research is needed to establish more definitive and comprehensive conclusions.

Purposes, Objectives, Research Questions and Hypotheses

Purposes

The purpose of the study is to explore the relationship between musical intelligence and critical thinking and problem-solving skills in terms of correlation, contribution, and difference across gender.

Objectives

The specific objectives of the study were.

- 1) to investigate students' score of musical intelligence and critical thinking problem-solving skill based on gender,
- 2) to investigate the difference of musical intelligence and critical thinking between male and female students.
- 3) to investigate the relationship of musical intelligence to the problem-solving skill,
- 4) to investigate the effect of musical intelligence on critical thinking and problem-solving skills among students.

Research Questions

The research questions are as follows.

1. What is the students' score of musical intelligence and critical thinking & problem-solving skill based on gender?
2. Are there any differences on musical intelligence and critical thinking skills among male and female students?

3. Is there a relationship between students' musical intelligence and their critical thinking & problem-solving skills?
4. Does students' musical intelligence affect their critical thinking and problem-solving skills?

Null Hypotheses

The following null hypotheses were made

- Ho1 There is no significance difference of musical intelligence among male and female students.
- Ho2 There is no significance difference of critical thinking problem solving skill among male and female students.
- Ho3 There is no significant relationship between musical intelligence and critical thinking and problem-solving skill.
- Ho4 There is no significant contribution of musical intelligence towards critical thinking problem-solving skill.

Methodology

This study employed a quantitative survey approach, which is well-suited for investigating psychological traits in their natural form, such as examining relationships between intelligence, behavior, and attitudes (Weirisma, 2000). This study utilized descriptive analysis to measure the means of musical intelligence and critical thinking problem-solving skills among male and female students. An independent t-test was employed to determine whether there were significant differences in the variables based on gender. Pearson correlation was employed to examine the relationship between musical intelligence and critical thinking problem-solving ability, while stepwise regression was utilized to determine the extent to which musical intelligence impacts critical thinking and problem-solving skills. This study was carried out at a private local university in Malaysia, where a random sample of 145 students was selected from a population of 240 students enrolled in September semester, year 2022. The research utilized a questionnaire consisting of three main parts: demographic information, musical intelligence as an independent variable, and critical thinking problem-solving skill as a dependent variable. A pilot test conducted showed that the questionnaires constructed and modified from the previous instruments have high reliability. The questionnaire proved to be highly reliable, with a Cronbach's alpha value of .886 for musical intelligence and .738 for critical thinking and problem-solving skill. The researcher adapted the items of musical intelligence questionnaire from MyMICA (Multiple Intelligences Checklist for Adults instrument) by (Rahayah et al., 2006). The critical thinking and problem-solving skill items used in the study were adapted from the soft skills instrument developed by Kamaruddin (2010), which is based on the Department of Higher Education instrument (2007) and some modifications made by the researcher. A pilot study was also carried out to determine the construct convergent validity by using the inter-item correlation test. According to the test results, the musical intelligence construct has a r value between .459 and .845 and the critical thinking and problem-solving skills construct has a r value between .413 and .634. The r value exhibits a moderate level of correlation strength based on standard level of correlation strength indicator based on (Pallant, 2011).

Analysis of Finding

To fulfil the purpose of the study, three tests were administered, that is descriptive statistical analysis to measure the means and Independent T Test analysis to determine the difference

of musical intelligence between male and female. Pearson Correlation was applied to measure the relationship between the variables and finally simple regression analysis used to know the impact or contribution of musical intelligence towards critical thinking and problem-solving skill.

1. What is the students' score of musical intelligence and critical thinking & problem-solving skill based on gender?

Table 1

Descriptive Analysis and Standard Deviation of Musical Intelligence and Critical Thinking and Problem-solving Skills according to Gender.

Variable	Gender	
	Male	Female
Musical Intelligence	23.47 6.9	21.64 6.3
Critical Thinking Problem & Solving-skill	29.32 5.2	27.69 4.7

Result of descriptive analysis shows that musical intelligence mean for male (m, 23.5) is higher than female (m, 21.6), mean of critical thinking problem-solving skills among male students (m, 29.3) is higher than female (m, 27.7). Table 2 shows the difference between musical intelligence and critical thinking and problem-solving skills based on gender.

2. Are there any differences on musical intelligence and critical thinking skills among male and female students?

Table 2

Difference of Musical Intelligence and Critical Thinking based on Gender.

Variables	Gender		Significance Value
	Male	Female	
Musical Intelligence	23.4	21.6	.141 (>.001)
Critical Thinking & Problem Solving Skill	29.3	27.7	.804 (>.001)

Male students had higher score in musical intelligence (M = 23.4, SD = 6.3) than female students (M = 21.6, SD= 6.9). There was no significance different among male and female, $t(69) = .405$, $p = .141$. Male students had higher score in critical thinking and problem-solving skill (M=29.3, SD=5.2) than female students (M=27.7, SD=4.7). There was no significance of critical thinking and problem-solving skill between male and female in the skill, $t(52) = .174$, $p = .084$. So, null hypothesis (Ho1) and (Ho2) that there is no significant difference of variable

across gender is accepted. Table 3 shows the relationship between musical intelligence and critical thinking and problem-solving skills.

3. Is there a relationship between students' musical intelligence and their critical thinking & problem-solving skills?

Table 3

Relationship of Musical Intelligence and Critical Thinking Problem-solving Skill

Relationship	Critical thinking & Problem-Solving Skill		Interpretation
	R	Sig.	
Musical Intelligence	.376	.000	Weak

A Pearson correlation was conducted to examine the relationship between musical intelligence and critical thinking problem-solving skill. Musical intelligence was weakly positive related to critical thinking problem solving skill, $r(1.0) = .376$ (r values between .30 - .50), $\text{sig}=.000$ ($p = <.001$). So, null hypothesis (H_03) that there is no relationship between the variables is rejected. Stepwise regression analysis was used to determine how musical intelligence affected the students' capacity of critical thinking and problem-solving skill. Some information that might have compromised the accuracy of the regression results was removed (through Case wise diagnostics analysis). The method specifies the execution of some linear regression assumptions, including the variance equality test, the normality test, and aspects of collinearity (Hair et al., 2006). By examining the table of normal probability plots and scatterplots, these suppositions can be verified (Pallant, 2005). Table 4 is the analysis of variance and Table 5 shows the analysis of stepwise linear regression.

4. Does students' musical intelligence affect their critical thinking and problem-solving skills?

Table 4

Analysis of Varians

	Sum of squares	Df	Mean Square	F	Sig.
Regression	470.807	1	470.807	22.609	<.001 ^b
Residual	2852.862	137	20.824		
Sum	3323.669	138			

Table 4 shows that the stepwise regression analysis conducted found that musical intelligence ($F = 22.609$, $\text{Sig} = <.001$) is a significant variance that provides a predictor of critical thinking and problem-solving skill. The contribution given by musical intelligence to skill such as the following Table 5.

Table 5

*Contribution of Musical Intelligence on Critical Thinking and Problem-Solving Skill**Contribution of Musical Intelligence on Critical Thinking and Problem-Solving Skill*

Variable	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	R2	Contribution
	B	Standard error	Beta				
Musical Intelligence	.282	.059	.376	3.058	<.001	.135	13.5 %
Constant	21.884	1.369		15.983	<.001		

The table shows that musical intelligence contributes only 13.5 percent (Beta = .376, $t = 3.058$, Sig = <.001 and $r^2 = .135$). It can be explained that there is a possibility of another remaining percentage, contributed by other factors to critical thinking and problem-solving skill that are not considered in this study (Pallant, 2005). Therefore, the null hypothesis (Ho4) was rejected.

Discussion

In general, the study found that male students outperformed female students in both variable. However, the detail of analysis discovered that gender has no influence on and plays no critical role in both musical intelligence and critical thinking as distinguishing male and female students. For the musical, the result is in line with result of study by Punia and Jyoti (2016), male and female do not differ in musical intelligence. However, study by Jeysankar and Ramalingam (2019) studied male and female Library and Information Science (LIS) professionals working in Tamil Nadu universities discovered that multiple intelligences, including musical intelligence, differed across gender. Sergeant et al (2022) male musicians considerably outnumbered females, while study by Milles et al (2016), women would be better than men at recognizing music especially in familiar melodies.

Traditional view always see that men are better at analytical thinking and therefore make better critical thinkers. It means that male students are smarter than female students when it comes to critical thinking and problem-solving skills. However, this perspective cannot serve as a basis for measurement as shown by this study that gender has been found to have not significant impact on critical thinking skills and creativity. The finding in line with the study by Ivna & Atik (2019), but study by Mawaddah et al (2018) imply that there is a gender difference in mathematical critical thinking skills. The result also showed that musical intelligence relates to critical thinking and problem-solving skills but has less of an impact on critical thinking and problem-solving skills. It is consistent with the research by Hakan et al (2017) study on the relationship between problem solving skills and multiple intelligence of high school students found there was a negative correlation between musical intelligence problem-solving skills and a current study by Dawahdeh & Yousef (2021) and Ali Mohammed and Mohammed (2021) that there is weak positive linear relationship between musical intelligence and thinking patterns. The analysis of this study however is not with the claims of Soleimannifar et al (2016) and Criscuolou et al (2019) as well as (Johnson, 2003).

It's worth noting that research in this notion can sometimes yield mixed or inconclusive results due to various factors such as methodology, sample size, and the specific measures used to assess musical intelligence and critical thinking problem-solving skills. Additionally, individual differences among participants can also impact the results. In response to the musical intelligence that became one domain of Gardner's multiple intelligence theory, the acceptance of theory has historically been contentious. Some academics have criticized it for lacking empirical evidence. But some have praised it for being effective in contemporary educational and professional contexts (Moulton & Rasmus, 2022). According to their research, there may not actually be a relationship between different types of intelligence, including musical intelligence, and skills at the workplace and project effectiveness.

Torres (2022) asserted that most criticism from scientists assume that musical ability is a talent and not intelligence. Intelligence is the ability to learn or understand information quickly and accurately. Musical ability is often seen as a talent rather than an intelligence in the traditional sense. The distinction between talent and intelligence can sometimes be subjective and context dependent. While talent and intelligence can be interconnected, they are not necessarily the same. Intelligence refers to the broader capacity to process information, solve problems, and adapt to various situations, whereas talent focuses on specific exceptional abilities within a particular domain. In the case of musical ability, talent may contribute to an individual's proficiency and mastery in a musical discipline. Ultimately, the distinction between musical talent and musical intelligence may depend on how one defines and interprets these terms. Some may use them interchangeably, while others may consider them as separate but related concepts. It's essential to recognize and value both the innate talent and the cognitive abilities that contribute to musical expertise.

According to some scientists, no one is born intelligent, but one must work from childhood to improve their skills given by the environment in which the individual develops, whereas talent is considered a natural skill or aptitude with which the person is born. Most studies show that intelligence is influenced by both genetic and environmental factors (Miller et al., 2022). Johnson (2011) proves in her study on examining the effects of music education on critical thinking skills found that students with musical training displayed higher levels of critical thinking abilities compared to their non-musical peers.

So, the environment is required for students to actively participate in multiple intelligence learning (Mohan, 2021). Study suggests certain strategies, such as instructors allowing students to include music for independent projects, connecting music to a lesson, discussing what music was popular during historical periods, and using songs to help students, should be used to enhance and assist learning with musical intelligence. Social and environmental factors have an impact on a person's critical thinking abilities. The increasing acceptance of music in today's world has led to many individuals valuing music as a significant part of their lives, thus making musical intelligence their preferred form of intelligence. The social interactions that music education promotes among students can create a conducive environment for the development of critical thinking skills. In addition, the demands of the twenty-first century require individuals to learn quickly, think in multiple dimensions, and be creative to adapt to new challenges and circumstances.

Integrating music-based activities in classroom instruction can be a creative approach to developing critical thinking and problem-solving skills. While musical intelligence may be considered a talent by some researchers, it still requires a supportive environment to foster critical thinking and problem-solving abilities (Gardner, 1983, 1992). Therefore, it is essential for students with musical intelligence to have opportunities to incorporate music into their

learning to enhance their critical thinking skills.

According to Capo (2018), incorporating music during studying can equip people with skills that are useful for the rest of their lives. It allows us to gain knowledge on how to approach issues from various angles. Music can instruct students on how to assess outcomes and revise their theories. By analyzing the provided information and developing their own solution, students can develop critical thinking skills that are critical for success. Students with other multiple intelligences, such as musical intelligence, can have critical thinking skills, and are not limited to logical and mathematical students.

To put it another way, critical thinking is not limited to people who are only gifted with mathematical reasoning and intelligence. It's important to note that while musical intelligence can contribute to critical thinking and problem-solving skills, it is just one aspect of intelligence. The development of critical thinking and problem-solving abilities also relies on other factors, such as education, experience, and the application of analytical and evaluative thinking across various domains. Nonetheless, musical intelligence can provide a unique and valuable cognitive foundation that supports these skills.

Conclusion

Critical thinking skills are required for success in the twenty-first century. Musical intelligence, unlike mathematical intelligence, is always regarded as an underutilized ability to generate critical thinking and problem-solving skills. The study shows musical intelligence had least impact on critical thinking problem-solving skill, while previous research proves music can assist students in developing basic mental skills, preparing the brain for achievement, and cultivating superior thinking abilities. It's important to consider that individual differences and various factors can influence the results of specific studies. Additionally, more research is needed to establish more comprehensive and definitive conclusions in this area. This study also shows that male students are more talented in music and have mastered critical thinking problem-solving ability than their female counterparts, so more strategies must be implemented in learning for female students. Lectures should also focus on each student's strengths and weaknesses based on gender differences.

It is important to note that research on gender differences in cognitive abilities has produced mixed results, and the magnitude of any observed differences tends to be small. Individual variations within each gender group are typically greater than the differences observed between genders. Factors such as cultural and societal influences, educational opportunities, and individual experiences can contribute significantly to cognitive development and performance, making it challenging to attribute differences solely to gender. Gender differences in cognitive abilities also are not universally consistent across all studies and populations. The presence or absence of gender differences can vary depending on the specific task or test used to measure critical thinking and problem-solving skills, the sample characteristics, and the cultural context.

Using musical intelligence among students as well as musical instruments to assist in teaching and learning is an effective and popular way in today's educational institutions to generate critical thinking among students. Higher order thinking aims to provide learners with the ability to synthesize relationships within and beyond specific fields of study. Thus, it is allowing their thinking to expand into the concreteness of the world. Students who study music not only improve their musical skills, but they also gain advantages in other academic areas. Music education has been shown in studies to improve mathematical achievement. This

means that musical intelligence cannot generate critical thinking on its own without the assistance of music, musical instruments, or what we call musical education.

So, musical intelligence should be aided by a musical environment or education. The study implied that a culture that values musical intelligence can improve critical thinking and problem-solving skills, whereas musical intelligence cannot produce critical thought in the absence of a conducive environment. Students who participate in a conducive musical environment education have improved their problem-solving abilities. For the musically intelligent students, they are far more sensitive to pitch, melody, rhythm, and tone. So, instructors are recommended to teach orally and through auditory media and understand that students with musical intelligence concentrate on associating and visualizing spoken content. Kruger and Merwe (2012) suggested that contemporary teaching models to teach musical intelligence learners should be realized optimally through a constructivist approach and a learner-centered means that require social interaction, action, cooperative, and problem-based learning.

Acknowledgment

Funded

This research received fund from Unitar International University (UNITAR), Malaysia.

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