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Integration of Music in Teaching and Learning the Concept of Chemical Bonding

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Abstract

Traditionally, chemical bonding has been a challenging concept for students to grasp. This study explores the effectiveness of integrating music into the teaching of chemical bonding among Grade 9 students at Lugait National High School. Using a non-equivalent experimental design with 60 students, the study compares traditional and music-integrated teaching methods through pre-test and post-test assessments. The results show that the integration of the Music method significantly outperforms the Traditional Method, with 50% of students achieving outstanding performance compared to 73.33% falling below the expected level in the traditional approach. Statistical analysis confirms a substantial difference in post-test scores, favoring the music-integrated method. Both methods demonstrate a significant improvement in science proficiency, with the integration of the Music method showing a more significant and impactful enhancement. The study suggests that integrating music not only enhances science proficiency but also contributes to sustained improvement compared to traditional methods. Recommendations include further longitudinal studies, diverse music genres, styles, interactive activities, and continuous feedback to optimize music-integrated learning alignment with diverse learning needs. For more details, refer to the full study.

Keywords: Chemical bonding, Music-integrated, Performance, Science proficiency

1. Introduction

Music? In science class? It might sound unconventional, but what if combining the universal language of music with the fascinating world of chemistry. "Imagine a symphony of knowledge where chemical bonds dance to the rhythm of understanding, and atoms harmonize in a melody of comprehension. In our exploration of the integration of music in teaching the concept of chemical bonding, we embark on a journey where the language of science is complemented by the artistry of music, creating a captivating ensemble that resonates in the minds of young learners."

Chemical bonding plays a central role across the chemistry curriculum at the secondary and tertiary levels. Ideas about chemical bonding is essential for drawing inferences about structure and function relationships as well as making connections to other topics such as thermodynamics. One reason so many students find chemistry difficult is the abstract nature of the concepts (Yakmaci-Guzel, 2013). Integrating music in the curriculum entails an extensive search on the part of the teacher because materials of all kinds and all fields of man's contemporary and past civilization will be needed. For instance, song lyrics aid with the retention of information (Tillman, 2013).

Incorporating music is beneficial to both teacher and student as it strengthens the bond between them through a (hopefully) mutually satisfying aesthetic experience. Learning in and through music is something that can happen formally (such as part of structured lessons in school), as well as in other-than-formal situations, such as in the home with family and friends, often non-sequentially and not necessarily intentional, and where participation in music learning is voluntary, rather than mandated, such as in a community setting (McPherson, 2018 et al). Schaerf (2018) found that music helps to stabilize mental and physical well-being which can facilitate an increase in attention span and help students attain a deeper state of concentration. Making learners more engaged during chemistry lessons would imply that teachers consider interactive instructional and learning strategies like songs. Through Songs, construction of concepts and transformation of learners from their passive states to active ones during chemistry classroom may be catalyzed. Collaborative composition and singing in a classroom may thus yield gratifying classroom interaction (Kisanga, 2015).

Engaging in learning through music is a very big help to those students because it can maximize learning and improve memory. Music represents an enjoyable activity in and of itself, but its influence goes beyond simple amusement. Composition of music is the act of conceiving a piece of music, the art of creating music, or the finished product (Coleredge-Taylor,2022). To put it simply, when accompanied by music new information becomes easier to remember. Students can connect particular data to a rhythm, and then use their memory of musical elements to recall the information following their association. Improving information absorption and together stand as a popular and powerful strategy for providing learning experiences that are far more efficient. Music is such a versatile tool that it offers opportunities for improvement in many aspects of the classroom. Governor et al. (2012) found among other benefits, understanding of taught concepts and acquisition of more examples. In addition, learner engagement increased because the interests of the learners were captured by the songs. Supporting the findings by governor and colleague, Bokiev et al., (2018) ascertained the potential of songs in engaging students and making adding pleasure to learning. Universally, adolescents have positioned music on top of their interests, suggesting that songs rich in science content could not only capture their interest during lessons but also enrich them with extra examples and ideas in each learning area.

Teachers now have a better opportunity and responsibility to enhance teaching and learning than ever before, even as the importance of the classroom setting has grown and changed over time. Being projected instructional strategies, the impacts of songs, and in this case science content songs in a classroom of chemistry seem infinite. Delightful songs can be successful in making learners who disconnected with science lessons develop some interest and become part of the classroom (Crowther, 2012). Further, if a science lesson is instructed using music, accompanied by singing and dancing, the lesson content is likely to reach participants of diverse ability through multiple modes. This implies that songs are likely to be applied as multimodal instructional resources in a chemistry lesson. This study is designed to explore the experiences of teachers and students when science-content music is used as a teaching strategy in the middle school science classroom in order to better understand the phenomenon and its potential use in science education. The incorporation of music is one of the specific strategies now commonly used to supplement

and enhance student learning. The main goal of this study is to determine the effectiveness of music integration to the teaching and learning the concept of Chemical Bonding. Here, the researchers aimed to investigate student's motivation, behaviour and productivity. Besides this, another aim of the research was to assess the academic performance of students.

2. Methodology

The study utilized an experimental design to quantify behaviors, attitudes, and relationships between variables, aiming to articulate facts, reveal patterns, and draw conclusions based on quantitative data to understand its purpose and as certain its dominance by seeking results that could be projected to a larger group. The process involved in collecting numerical data and information, which was used to identify patterns, calculate averages, make predictions, and test causal relationships. The study encompassed three variables: teaching and learning through music integration, teaching and learning through traditional methods, and the academic performance of the students. The respondents of the study comprised the entire sections of Grade 9 Compassionate and Grade 9 Courageous, each consisting of 30 students from Lugait National High School (LNHS), Poblacion, Lugait, Misamis Oriental. The respondents were selected using a non-equivalent groups design, meaning that the participants were not randomly assigned to either the music-integrated or traditional teaching method groups. Instead, existing groups or classes were used, and one group received the music-integrated teaching while the other group received traditional teaching methods. This design allows for comparison between the two methods but does not ensure equivalence between the groups at the outset. Students in the two sections were administered a pre-test on their understanding of chemicalbonding. Subsequently, one section was exposed to the lesson through music integration, where the researcher presented songs that they had composed. The melodies and lyrics clarified complex concepts of chemical bonding, engaging students through different ways of learning. In contrast, the traditional teaching method employed by the researcher involved straightforward discussions of chemical bonding principles without musical accompaniment. Finally, each section underwent a post-test assessment. This approach ensured that every member of the population had an equal opportunity to participate in the study. The pre-test and post-test standardized questionnaires used in the study each consisted of thirty (30) multiple-choice questions. These questions were designed by the researcher specifically for assessing the students' understanding of chemical bonding concepts. Multiple-choice questions were chosen as they allow for efficient and objective assessment of knowledge retention and comprehension. The questions likely covered various aspects of chemical bonding, such as types of bonds (ionic, covalent, metallic). Standardized procedures were likely followed in the creation of these questionnaires to ensure consistency and reliability in measurement across all participants. The survey questionnaire had two (2) parts: Part I of the research involved administering 30 multiple-choice pre-test questions to each of the two sections, covering identical topics. Following this, Part II comprised 30 multiple-choice post-test questions, also addressing the same topics. The post-test aimed to evaluate the influence of music integration on learning chemical bonding concepts and its impact on academic performance compared to traditional methods. Each test session lasted for 50 minutes, allowing ample time for both the pre-test and post-test assessments. The researcher composed songs related to chemical bonding topics, integrating them into the lesson plan. Specifically, three songs were created for each topic: "Ionic Bonding," "Covalent Bonding," and "Metallic Bonding." The tunes for these songs were adapted from popular songs like "Cupid – fifty-fifty," "You Belong with Me" by Taylor Swift, and "Flowers" by Miley Cyrus. These contemporary tunes were chosen to resonate with current trends

and engage students effectively. The implementation involved playing these songs during the lesson and incorporating them into discussions and activities to reinforce understanding of the bonding concepts, which served as a guide for teaching both the traditional method and the method involving the integration of music.

3. Results and Discussion

The pretest score in science of the students when grouped according to Integration of Music and Traditional Method

The pretest score in science of the students, when grouped according to the Integration of Music and Traditional Method, offers valuable insight into the baseline understanding of students before they are exposed to different teaching methods. This context sheds light on the initial level of comprehension and knowledge among students in science, providing a reference point for assessing the effectiveness of both music-integrated and traditional teaching approaches. By examining pretest scores within these distinct groups, educators and researchers can better understand the starting point of students' understanding and subsequently evaluate the impact of different instructional methods on their academic performance and learning outcomes.

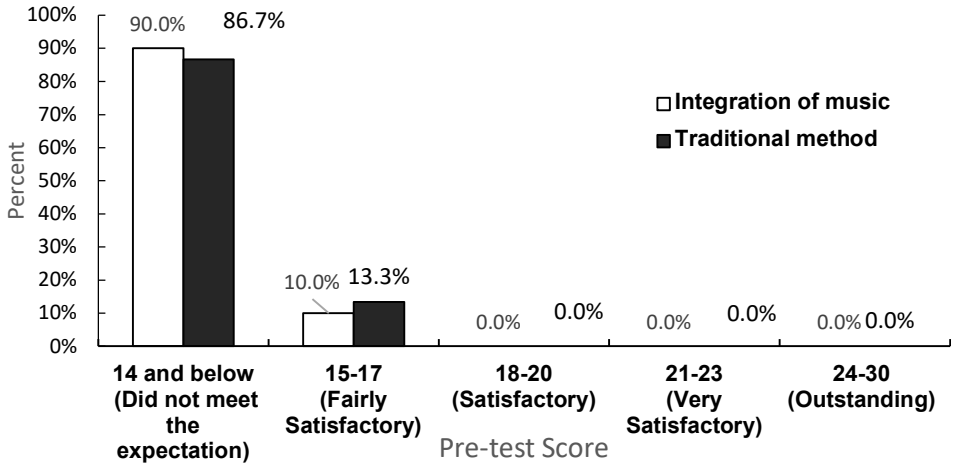

Figure 1. Percentage distribution of the pre-test score in science of the student using Integration of Music and Traditional Method

Figure 1 provides a breakdown of pre-test scores in science for students when grouped according to the integration of music and traditional teaching methods. The highest frequency in the Integration of Music category is observed in the score of 14 and below which Did not meet the expectation, constituting 90.00% of the students while only 10% respondents got score of 15 to 17 which is fairly satisfactory. This indicates that majority of students when not yet exposed to the integration of music in their science learning, fell below the expected level of performance in the pre-test.

In the Traditional Method category, the highest frequency is also in the "14 and below (Did not meet the expectation)" group, though slightly lower at 86.67% while only 13.33% respondents got score of 15 to17 which is fairly satisfactory. This suggests that a substantial majority of students did not meet the expectation in the Science pre-test.

Supporting this data are the findings of Omar et al. (2013), whose research suggests factors beyond instructional methods might contribute to the underwhelming pre-test scores in both groups. Lack of prior knowledge in related concepts, the abstract nature of

chemical bonding itself, and potentially ineffective teaching methods emphasizing rote memorization could be influencing student performance. Additionally, a study by Chan (2015) investigated the potential of music and movement to enhance chemical bonding learning in ninth graders. Although both groups started with similarly low pre-test scores, indicating a pre-existing difficulty with the topic. However, the overall achievement levels of both groups remained relatively low, suggesting that neither instructional approach was entirely successful in facilitating deep understanding of chemical bonding concepts.

Post-test score in Science of the Students using Integration of Music and Traditional Method

The post-test score in Science of the students, categorized by the Integration of Music and Traditional Method, offers a crucial assessment of the effectiveness of these teaching approaches. It provides a snapshot of students' comprehension and retention of scientific concepts following exposure to either music-integrated or traditional teaching methods. This context allows educators and researchers to gauge the impact of each instructional approach on students' academic performance and learning outcomes. By comparing post-test scores between the two groups, insights can be gained into which method may be more effective in enhancing students' understanding and mastery of scientific principles.

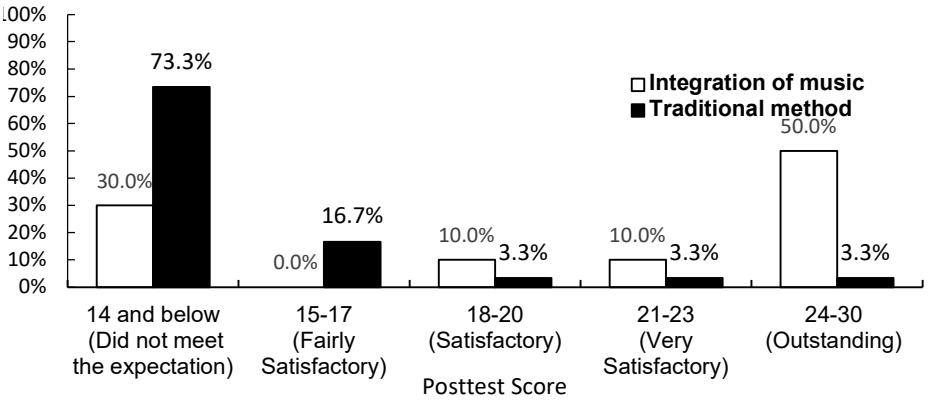

Figure 2. Percentage distribution of the post-test score in science of the student using Integration of Music and Traditional Method

Figure 2 provides a breakdown of post-test scores in science for students when grouped according to the integration of music and traditional teaching methods. The highest percentage in the Integration of Music method is observed in the score from 24-30 described as Outstanding, constituting 50.00% of the students. This suggests that a significant proportion of students, when exposed to the integration of music, achieved an outstanding level of performance in the post-test for science. Conversely, the lowest frequency is observed in the score from 15 to 17 described as (Fairly Satisfactory), where no students achieved a fairly satisfactory level. This indicates that no students in this age group, when exposed to the integration of music, reached the expected level of fairly satisfactory performance in the post-test. In traditional method the highest frequency is observed in the score of 14 and below which did not meet the expectation, constituting 73.33% of the students. This suggests that a substantial majority of students, when taught through traditional methods without the integration of music, did not meet the expected level of performance in the post-test for Science. Conversely, the lowest frequency is distributed across the score were 18-20 (Satisfactory), 21-23 (Very Satisfactory), and 24-

30 (Outstanding), each representing 3.33% of the students. This implies that only a small percentage of students achieved satisfactory, very satisfactory, or outstanding levels of performance when subjected to traditional teaching methods.

Supporting the observed differences in science proficiency between the integration of music and traditional teaching methods draws upon existing research. Juslin and Zentner (2003) reviewed studies demonstrating music's positive effects on memory, attention, and spatial reasoning, all crucial cognitive functions for learning scientific concepts. This aligns with the significantly higher percentage of "Outstanding" scores in the music integration group, suggesting enhanced processing abilities that led to deeper understanding and mastery. Additionally, as found by Wangari (2011), though the Kenyan government invests hugely in chemistry and other science subjects, exam results still indicate low performance among the students. The reduced interest and engagement in chemistry could be blamed on ancient teaching method, the most common one being lecture method. Even though most classroom teachers practice lecture method, it encourages learner passivity and catalyses learner disinterest in learning since it is a teacher centred pedagogy (Izuagba, 2015).

Difference between the pre-test performance in science using Integration of Music and Traditional Method

The difference between the pre-test performance in Science using Integration of Music and Traditional Method serves as a baseline comparison to assess initial understanding levels among students. This context is essential for understanding the starting point of students' knowledge before exposure to different teaching methods. By examining the discrepancy between pre-test scores in these distinct instructional groups, educators and researchers gain insights into the potential impact of each approach on students' academic performance and learning outcomes. This comparison enables the identification of any initial disparities in comprehension levels, which informs the evaluation of the effectiveness of music-integrated and traditional teaching methods in improving students' understanding of scientific concepts.

Table 1. Difference between the pre-test scores in science of the students in Integration of Music and Traditional Method using t-test for two Independent Samples

Pre-test	mean	mean difference	t-value	p-value	remarks
Integration of music	10.77				
		0.10	0.139	.890	Not Significant
Traditional method	10.67				

With 0.05 level of significance

Table 1 shows the difference between the pre-test scores in science of the students in Integration of Music and Traditional Method. The analysis shows that such difference is not significant since the t-value is 0.139 that correspond to the p-value of 0.890 is greater than 0.05 level of significance. The non-significant difference in pre-test scores indicates that, from a baseline perspective, both groups started with a comparable level of Science proficiency. This homogeneity in the initial conditions enhances the validity of comparing the impact of the Drilling and Traditional Methods on subsequent performance.

A key finding from Williams and Brown's (2019) study offers compelling evidence for incorporating music into science education. Notably, their pre-test revealed no significant differences in chemistry knowledge between the music-integrated and traditional instruction groups, establishing a crucial baseline for assessing the intervention's impact. This eliminates concerns about pre-existing disparities influencing

post-test results, allowing us to confidently attribute any observed changes in retention directly to the music intervention. In conclusion, Williams and Brown's study provides a promising glimpse into the potential of music to bridge knowledge gaps and revolutionize science learning. With its ability to level the playing field and boost retention, incorporating music into science classrooms emerges as a valuable strategy for fostering deeper understanding and a lifelong love of the subject in ninth graders and beyond.

Difference between the post-test scores in Science among grade 9 students in Integration of Music and Traditional Method in teaching

The difference between the post-test scores in Science among grade 9 students in Integration of Music and Traditional Method in teaching highlights the varying effectiveness of these instructional approaches in enhancing students' understanding and retention of scientific concepts. This context underscores the importance of assessing the impact of different teaching methods on academic performance, particularly in the context of integrating music into the learning process. By examining the discrepancy in post-test scores between the two groups, educators and researchers gain insights into which method may be more conducive to facilitating student learning and achievement in science.

Table 2. Difference between the post-test scores using t-test for two independent Sample in Science in Integration of Music and Traditional Method

Post-test	mean	mean difference	t-value	p-value	remarks
Integration of music	20.40				
		8.10	6.080	.00001	Significant
Traditional method	12.30				

With 0.05 level of significance

Table 2 shows the difference of post-test scores in Science of the students in Integration of Music and Traditional Method. The analysis shows that such difference is significant since the t-value is 6.080 that correspond to the p-value of 0.0001 is less than 0.05 level of significance. This significant difference is in favor of Integration of Music (mean =20.40) since it has higher mean compared to Traditional Method (mean=12.30).

The Integration of Music group's higher mean suggests that students who were exposed to this teaching strategy saw a more notable improvement in their Science proficiency. There are various ramifications for this outcome. First of all, it implies that, in comparison to the Traditional Method, the Integration of Music was more successful in encouraging students' gains in their Science proficiency. The Integration of Music's favorable statistical difference highlights its potential as a more effective teaching strategy for improving science proficiency.

Secondly, the significant difference in average scores suggests that integrating music has a notable educational impact. The higher mean indicates that students who participated in integrating music showed a greater level of proficiency in understanding chemical bonding compared to their peers who attended traditional lectures.

In summary, according to Diakou's (2013) study, songs have the ability to evoke positive emotions, which in turn enhances motivation and improves attention retention. This finding is further reinforced by the higher mean score of the Integration of Music group, which indicates a statistically significant advantage of using this instructional strategy in promoting language learning outcomes. Moreover, the significant difference in post-test scores between the Integration of Music and Traditional Method groups implies that the former was more successful in improving students' science proficiency. Likewise, a study conducted by Yoon and Kim (2017) on the use of music in science instruction

demonstrated that it had a positive effect on participants' attitudes and comprehension of the subject.

Difference between the pre-test and post-test scores in Science in Integration of Music and traditional approach

The difference between the pre-test and post-test scores in Science in Integration of Music and traditional approaches offers insight into the effectiveness of these teaching methods in enhancing students' understanding and performance over time. This context underscores the significance of assessing the impact of instructional strategies on academic outcomes, particularly in the context of incorporating music into the learning process. By comparing the pre-test and post-test scores within each approach, educators and researchers can evaluate the degree to which students' comprehension and retention of scientific concepts have improved, thus informing decisions on pedagogical approaches and curriculum design.

Table 3. Difference between the pre-test and post-test scores in science of the students in Integration of Music and Traditional Approach

Difference	Mean	Mean Difference	t-value	p-value	remarks
Drilling Method (Pretest-Posttest)	10.76-20.40	-9.642	-9.573	<0.0001	Significant
Lecture Method (Pretest-Posstest)	10.67-12.30	-1.630	-2.564	0.016	Significant

With 0.05 level of significance

Table 3 shows the difference between pre-test and post-test scores in science of the students in Integration of Music and Traditional Approach. In the case of the Integration of Music, the analysis unveils a highly significant difference in pre-test and post-test scores, as indicated by the substantial t-value of -9.573 and an associated p-value of <0.00001. The robust statistical significance of this result is highlighted by the p-value being less than the standard significance level of 0.05. In the context of the Integration of Music, an increase in scores from the pre-test to the post-test is indicated by the negative sign of the t-value, which is a positive outcome indicating a significant improvement in science proficiency. This very important outcome clearly demonstrates how well the Integration of Music works to help students make significant progress in their Science skills.

There were significant differences in the motivation, engagement and proficiency in chemistry of the learners before and after exposure to music-based teaching. On the other hand, there were no significant differences in the motivation, engagement and proficiency in chemistry of the learners before and after exposure to non-music-based teaching (Burila 2021). This present study supported the findings of McCammon (2008) which revealed that using music keep science fun, Seizing the interest of learners, and consequently increasing achievement. Music has been used as a teaching strategy to educate young learners as it allows them to enjoy Science instruction and introduces science to learners who many not be interested in the field. This was further corroborated by a study comparing the Integrated Music and Traditional Approach instructional methods. Both approaches led to statistically significant improvements in students' science proficiency, as evidenced by pre-test and post-test score differences. However, the Integrated Music group, with its larger t-value, demonstrated a more substantial and impactful boost in

science progress. These findings offered valuable insights for educators who sought evidence-based guidance in selecting effective language learning methods. Furthermore, research by Werner (2018) suggested that incorporating pedagogical songs – specifically designed for classroom use and targeted at specific linguistic elements – could further enhance verbal recall by harnessing the memory benefits of music. So, the next time you planned your lessons, consider the power of music. It could be the missing ingredient that transformed your classroom into a vibrant and productive learning space where students were not just absorbing information, but actively engaged and excited to learn.

Analyses conducted using the Traditional Method also show a significant difference between pre- and post-test scores. The statistical significance of this result is emphasized by the t-value of -2.564 and the corresponding p-value of 0.016, which is less than the 0.05 level of significance. The negative sign of the t-value denotes an increase of scores from the pre-test to the post-test, much like the Integration of Music. Within the framework of the Traditional Approach, this indicates that science proficiency has significantly improved. Notwithstanding its importance, this finding implies that students' proficiency did significantly improve as a result of the Traditional Approach. In line with Fink's (2003) focus on achieving "meaningful learning" through clearly defined goals, research indicates that even traditional teaching methods, such as lectures, can be effective when they are aligned with learning objectives, use clear language, and incorporate questioning and review. These findings are consistent with studies that examine the potential of music in education.

The study's exploration of integrating music into teaching chemical bonding among Grade 9 students reveals promising insights into enhancing learning outcomes. While pre-test scores showed no significant difference between traditional methods and music integration, post-test results exhibited markedly higher mean scores for the latter, indicating its effectiveness in augmenting students' Science proficiency. This underscores the importance of innovative instructional strategies, such as music integration, to engage students and cater to diverse learning preferences. Continuous feedback mechanisms are recommended to refine music-integrated learning experiences, while longitudinal studies are suggested for deeper insights into its sustained impact. Overall, the findings emphasize the potential of music integration to enrich Science education and improve student learning outcomes, urging educators to embrace innovative approaches for more effective teaching and learning experiences.

4. Conclusion

The study effectively addresses its learning objectives through the conclusions drawn from the findings:

1. Comparison of Pre-test Scores: The study successfully compared the initial proficiency levels of students in both the Integration of Music and Traditional Methods groups. Finding no significant difference in pre-test scores indicates that students began with similar levels of proficiency in understanding chemical bonding.

2. Comparison of Post-test Scores: By comparing post-test scores, the study demonstrated a significant difference in proficiency levels after exposure to either the Integration of Music or Traditional Methods. The Integration of Music group showed markedly higher mean scores, indicating a more effective learning experience.

3. Effectiveness of Integration of Music: Through analysis, the study determined that integrating music into science instruction was more effective in enhancing students proficiency in chemical bonding. The higher mean scores and greater improvements from pre-test to post-test in the Integration of Music group support this conclusion.

4. Positive Impact of Music Integration: The study highlighted the positive impact of integrating music into science instruction, emphasizing its efficacy in improving science

learning outcomes. Educators seeking evidence-based approaches to enhance students' proficiency in chemical bonding may find incorporating music into their teaching methods beneficial, based on the study's findings.

The researcher concluded that the findings of the analysis supported the assertion that integrating music into teaching Science led to significantly greater improvements in student's proficiency compared to the Traditional Method. This conclusion emphasizes the efficacy of integrating music as an instructional strategy in elevating Science learning outcomes among students.

5. Recommendations

This study demonstrates the effectiveness of integrating music into teaching and learning the concept of chemical bonding. The results unmistakably showcase the positive impact of music integration on student learning outcomes. To enhance the study, the following recommendations are presented:

1. This study was conducted over a short period, it is advisable for future researchers to undertake comprehensive longitudinal studies. These studies would help assess the sustained impact of music integration on student's academic performance over an extended period.
2. Employ diverse instructional approaches by integrating various music genres, styles, and interactive activities into the curriculum to cater to diverse learning preferences.
3. The researchers recommended that gathering continuous feedback from students regarding their experiences with music-integrated learning to optimize its alignment with their learning needs.
4. Encouraging educators to promptly incorporate music integration techniques into their classroom practices, ensuring immediate exposure and benefits for student learning and engagement.

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