EVALUATING THE IMPACT OF LO-FI MUSIC ON CONCENTRATION IN PHYSICS LEARNING AMONG SENIOR HIGH SCHOOL STUDENTS

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Abstract
Learning concentration is a key component of an effective learning process, particularly for students who frequently encounter various distractions. In the modern era, adolescents often listen to music while studying, and previous studies have shown that music may either enhance or hinder concentration. However, research on the specific influence of low-fidelity (lo-fi) music remains limited. This study employed a quantitative approach with a pre-experimental design involving Grade XI science students at SMAN 1 Dramaga, Bogor. A total of 70 students participated, divided evenly into experimental and control groups. Research instruments included observation sheets, detailed lesson plans (RPP), and questionnaires. The experimental group received treatment by listening to lo-fi music played at medium volume during teacher explanations and at a slightly higher volume during individual tasks, while the control group learned without music. Data were analyzed using an independent samples t-test. The results showed a significance value (2-tailed) of 0.444, which is higher than 0.05, indicating that the null hypothesis could not be rejected. Although the experimental group demonstrated marginally higher concentration levels than the control group, the difference was not statistically significant. Therefore, it can be concluded that the use of low-fidelity (lo-fi) music does not significantly influence the learning concentration of Grade XI science students in physics classes at SMAN 1 Dramaga, Bogor.

Introduction

Education is an essential activity undertaken by individuals or groups to help shape attitudes and behaviors, enabling them to become better individuals than before (Attahakul, 2025). Quality education involves smooth, effective, and efficient learning processes (Nwakoby, 2025); thus, the success of educational goals depends on how students experience and engage in the learning process at school (Hasanah et al., 2017). Education is structured in stages that must be completed, and through these stages, the learning process aligns with students' abilities, ultimately enhancing their knowledge, insight, and experience. This learning process requires concentration to understand and absorb the material being studied. Concentration, therefore, plays a crucial role in ensuring an effective learning process (Juita, 2020).

Concentration refers to focusing one's attention on a particular situation or object, allowing an individual to understand and interpret it fully (Andita & Desyandri, 2019). It influences students' ability to comprehend and process the material presented by teachers. Achieving concentration requires a relaxed and calm environment, as a tense atmosphere can interfere with focus and hinder optimal brain performance (Apriyani, 2015). Learning concentration is necessary not only for specific subjects or study fields but across all learning activities. In high schools, for example, both science (MIPA) and social studies (IPS) students need good

concentration to master their respective materials.

Based on an observation conducted with a physics teacher at SMAN 1 Dramaga, some grade XI science students struggled to maintain concentration during lessons. This issue stemmed from internal factors such as students' learning activities and interests, as well as external factors like *classroom* environment, facilities, curriculum, teaching methods, or even the teacher's approach. The researcher observed that some students chatted with their peers during lessons, paid little attention to explanations, appeared unfocused, or even sleepy.

Therefore, engaging learning methods are needed to help students stay calm and focused during lessons. Teachers can employ various methods to facilitate learning effectively and *achieve* educational objectives. One such method is using background music, which can help students feel more relaxed while studying (Andita & Desyandri, 2019). Beyond relaxation, music can also help reduce stress and has proven benefits for mental health across all age groups—children, adults, and the elderly. Music provides pleasure through rhythm, melody, and timbre, which can positively affect the body, mind, and emotions (Andita & Desyandri, 2019).

Listening to music is a common activity for many people, often used to elevate mood or relieve sadness. Researchers from the University of Missouri found that listening to music can improve *emotional* well-being. Beyond mood regulation, music also offers several cognitive benefits, such as enhancing concentration during study sessions among adolescents (Airin, 2022). Today's technological advancements make music easily accessible everywhere—at home, in vehicles, on television or radio, and at workplaces (Carl & Kutsidzo, 2017). The widespread availability of internet access allows people to enjoy music conveniently through streaming platforms like YouTube, Spotify, JOOX, and Apple Music.

Previous research has explored the relationship between music and concentration. For instance, Pramono and Gundandi (2019) studied the effects of jazz and classical music on concentration and reading comprehension among women aged 18–25. Their results showed that both genres improved performance compared to silence. Similarly, Denny Salim's study, *The Effect of Music on Learning Concentration among Second-Grade Students at SMUK 1 Salatiga*, revealed that background music influenced students' concentration positively or negatively, depending on several factors: (1) music preference, (2) emotional response to the music, (3) music characteristics, (4) familiarity with the subject matter, (5) volume, and (6) timing of playback (Taha, 2017).

In today's modern era, most adolescents frequently listen to music. Adolescence, defined as the developmental stage between the ages of 10 and 21, is a period when individuals transition into adulthood (Diananda, 2019). Listening to music can train adolescents to improve focus during study sessions. Recently, a new genre known as *low fidelity* or *lo-fi* music has gained popularity among youth. Lo-fi is an aesthetic form of recorded music characterized by technical imperfections such as static noise, background hum, or tape hiss (Supper, 2018).

Lo-fi music includes elements typically absent in professional recordings, such as off-key notes, ambient noise, and imperfections in sound production (John, 2018). Adolescents can easily access this music through gadgets, as many YouTube and Spotify channels stream lo-fi music live. Around 2016, lo-fi music became popular in Japan and the United States, primarily used for studying and relaxation. The genre gained traction in Indonesia around 2019, spreading widely through TikTok and being embraced by many listeners (Airin, 2022).

Lo-fi music creates a calm atmosphere with its soothing beats and repetitive melodies. It

often incorporates jazz chords, drum loops, and natural sounds such as rain or birdsong, typically played at 70–90 BPM. One of the most famous lo-fi channels, *ChilledCow*—now known as *Lo-fi Girl*—held one of the longest-running live streams on YouTube, lasting 13,165 hours and accumulating over 218 million views since it began on August 22, 2018, until February 23, 2020.

Research on lo-fi music remains limited, as the genre is relatively new among young audiences. However, a study by Airin (2022) from the Indonesia University of Education examined adolescents' interest in lo-fi music at Faste Coffee Shop, Bandung. The findings showed that lo-fi music was chosen to create a comfortable and focused atmosphere for customers working or studying in the café.

Based on this background, the present study aims to examine *The Effectiveness of Low Fidelity (Lo-fi) Music on Learning Concentration among Grade XI Science Students in Physics Class at SMAN 1 Dramaga, Bogor*. The indicators of learning concentration are adapted from Abin Syamsudin (2016), which include focused attention, observation, verbal responses, statements, and psychomotor reactions. The researcher chose lo-fi music as a learning aid considering the characteristics of the grade XI science students, who enjoy fun learning environments but still struggle with maintaining focus. Some students are often distracted, daydream, chat with peers, or appear sleepy during lessons, reflected in their physics scores, which remain below the minimum mastery criteria (KKM). Moreover, physics instruction at SMAN 1 Dramaga has never used music as a learning medium, relying instead on conventional lecture-based methods. Therefore, this study seeks to determine the extent to which lo-fi music can enhance students' concentration and create a more comfortable learning environment.

Method

This study employed a quantitative approach using a pre-experimental design. According to Sugiyono (2018), this type of research is not yet considered a true experimental design. The researcher applied a treatment in the form of low-fidelity (lo-fi) music to the experimental group of grade XI science students (MIPA) at SMAN 1 Dramaga, Bogor, during physics lessons. The study was conducted from January to February 2023, with class XI MIPA 7 serving as the experimental group and class XI MIPA 5 as the control group. Both were conducted through in-person learning sessions.

The indicators of students' learning concentration in this study were based on observable aspects. These indicators are presented in Table 1.

Table 1. Aspects and Indicators of Learning Concentration

Observed Aspect	Learning Concentration Indicators
Focused Attention	Directing gaze toward the teacher, the board, and learning media used during the lesson
Paying Attention	Paying attention to the material and information delivered by the teacher
Verbal Response	Responding positively or answering questions appropriately; providing negative responses if unrelated; hesitating when problems are unclear
Giving Statements	Providing supportive statements or counterarguments with reasons
Psychomotor Response	Taking notes of information obtained; completing tasks on time

The research design implemented in this study was the Intact Group Comparison Design, consisting of two classes: an experimental class (receiving the treatment) and a control class (without treatment).

In Figure 1, X represents the treatment applied in this study—namely, the use of low-fidelity (lo-fi) music during lessons. The experimental group (O_1) consisted of 35 students from class XI MIPA 7, while the control group (O_2) consisted of 36 students from class XI MIPA 5. The experiment was conducted by playing lo-fi music to the students during the learning process. When the physics teacher explained the material, the music was played at a low to medium volume; during independent work, the volume was adjusted to a medium or slightly higher level.

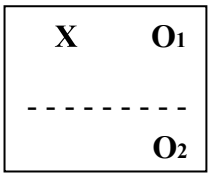

Figure 1. Intact Group Comparison Design (Sugiyono, 2018)

The duration of the lo-fi music exposure was approximately 30–45 minutes each Thursday from 10:25 a.m. to 11:50 a.m. during physics lessons, over three consecutive weeks (three meetings). On the first meeting (January 19, 2023), students were introduced to and briefed on lo-fi music, followed by the lesson on the topic *Kinetic Theory of Gases*. In the second meeting (January 26, 2023), the teacher reviewed the same topic while playing lo-fi music. In the final session (February 2, 2023), students completed a learning concentration questionnaire to measure the effects of the lo-fi music. The questionnaire scores were then used to analyze whether the use of lo-fi music was effective in improving learning concentration.

Reliable and valid instruments were used to ensure accurate data collection. The research instruments included an observation sheet, a detailed lesson plan (RPP), a learning concentration scale in the form of a questionnaire, and documentation of classroom activities. The questionnaire was distributed in printed form to students during class. The instrument used to measure concentration was adapted and further developed from an existing, validated questionnaire. The questionnaire statements were structured based on the indicators of learning concentration. After data collection, the researcher performed data analysis and processing.

The data analysis techniques used in this study included descriptive analysis and inferential statistical analysis, consisting of the normality test, homogeneity test, and hypothesis testing. Statistical testing was conducted at a significance level of 0.05 (5%). The hypothesis test employed was the independent t-test, used to determine whether there were significant differences between the experimental and control groups after the application of the low-fidelity (lo-fi) music treatment.

Results

Descriptive Analysis

The descriptive analysis involved processing data from both the experimental and control classes. The results were used to determine the students' concentration levels in physics learning, including the highest score, lowest score, mean, standard deviation, variance, and coefficient of variation. This analysis aimed to compare the learning concentration between students in the experimental and control groups.

Table 2. Learning Concentration Data of Class XI MIPA 7 (Experimental Group)

Parameter	Value
Sample	35

Maximum	113
Minimum	69
Mean	89.4
Standard Deviation	8.81910
Variance	77.776
Coefficient of Variation	10%

Based on Table 2, the highest learning concentration score of students in the experimental class was 113, while the lowest was 69. The mean score was 89.4, with a standard deviation of 8.81910, a variance of 77.776, and a coefficient of variation of 10%. The coefficient of variation represents the degree of uniformity in the treatment; the lower the coefficient, the more consistent the treatment effects are across participants.

The posttest data were obtained after the treatment was administered. This posttest measured students' learning concentration in both the experimental class (XI MIPA 7) and the control class (XI MIPA 5). The following table presents the posttest results for the experimental group.

Table 3. Frequency Distribution of Learning Concentration in the Experimental Group (Posttest)

Category	Score Range	Frequency	Percentage
Low	32–55	0	0%
Moderate	56–79	4	11%
High	80–103	29	83%
Very High	104–128	2	6%
Total		35	100%

Table 3 shows that 89% of students in the experimental class fell within the *high* and *very high* concentration categories. Specifically, 2 students (6%) demonstrated very high concentration, 29 students (83%) had high concentration, and 4 students (11%) showed moderate concentration.

Table 4. Learning Concentration Data of Class XI MIPA 5 (Control Group)

Parameter	Value
Sample	35
Maximum	100
Minimum	75
Mean	87.86
Standard Deviation	7.926
Variance	62.831
Coefficient of Variation	11.08%

Table 4 indicates that the highest concentration score in the control class was 100, while the lowest was 75. The mean score was 87.86, with a standard deviation of 7.926, a variance of 62.831, and a coefficient of variation of 11.08%.

Table 5. Frequency Distribution of Learning Concentration in the Control Group (Posttest)

Category	Score Range	Frequency	Percentage
Low	32–55	0	0%
Moderate	56–79	7	20%
High	80–103	28	80%
Very High	104–128	0	0%
Total		35	100%

Table 5 shows that 28 students (80%) in the control group were in the *high* concentration

category, while 7 students (20%) were in the *moderate* category. No students were in the *very high* or *low* categories.

Data Analysis

The first stage of data analysis involved a normality test to determine whether the data were normally distributed. The Kolmogorov–Smirnov test was applied with a significance level of 5% (0.05). If the significance value is greater than 0.05, the data are normally distributed; otherwise, they are not (Usmadi, 2020).

Table 6. Normality Test Results

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Kelas	Statistic	df	Sig.	Statistic	df	Sig.
Konsentrasi Belajar Siswa	Eksperiment	.142	35	.073	.956	35	.173
	Kontrol	.122	35	.200*	.921	35	.015

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The results in Table 6 show that the Asymp. Sig values for the experimental and control classes were 0.073 > 0.05 and 0.200 > 0.05, respectively, indicating that both datasets were normally distributed. The normality test was conducted using IBM SPSS version 26.

Next, a homogeneity test was conducted to determine whether the population variances between samples were equal. The Levene's Test was used, where a significance value greater than 0.05 indicates homogeneous variances (Usmadi, 2020).

Table 7. Homogeneity Test Results

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Konsentrasi Belajar Siswa	Based on Mean	.003	1	68	.959
	Based on Median	.000	1	68	1.000
	Based on Median and with adjusted df	.000	1	63.796	1.000
	Based on trimmed mean	.004	1	68	.951

Table 7 shows a significance value of 0.959 (> 0.05), indicating that the variances between the experimental and control groups were homogeneous.

To test the hypothesis, an *independent samples t-test* was performed to compare the mean learning concentration scores between the experimental and control groups. The decision rule was as follows: if the significance value (2-tailed) < 0.05, H_a is accepted and H_0 is rejected; if > 0.05, H_a is rejected and H_0 is accepted.

Table 8. Independent Samples T-Test Results

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Konsentrasi Belajar Siswa	Equal variances assumed	.003	.959	.770	68	.444	1.54286	2.00434	-2.45674	5.54246
	Equal variances not assumed			.770	67.240	.444	1.54286	2.00434	-2.45756	5.54328

The *t*-test results (Table 8) show a significance value (2-tailed) of 0.444 (> 0.05), indicating that H_a was rejected and H_0 was accepted. Although the experimental group had a slightly higher mean learning concentration than the control group (a difference of 1.543 points), the difference was not statistically significant. Therefore, the use of lo-fi music did not significantly affect the learning concentration of students in grade XI MIPA physics classes at SMAN 1 Dramaga, Bogor.

Discussion

The physics material used in this study was theoretical in nature. In such lessons, students are required to maintain focus to understand and absorb the material effectively. This study implemented lo-fi music as an experimental medium to assess its effectiveness in enhancing students' learning concentration during physics lessons. Posttest questionnaires, which had been tested for validity and reliability on non-respondent groups, were used to measure concentration levels after treatment.

The experimental treatment involved playing lo-fi music during instruction. At the start of the lesson, the researcher introduced lo-fi music to the class, after which the teacher delivered the material according to the lesson plan. The music used was a playlist from the YouTube channel *"ChilledCow"* (now *"Lo-fi Girl"*), titled *"Study Session – Lofi Hip Hop/Study Beats."* The volume was kept low during the teacher's explanation and increased during individual task sessions. Each session lasted 45 minutes. The goal was to help students stay focused and relaxed during learning. In contrast, the control class received no musical treatment but learned the same material.

The study aimed to determine the effectiveness of lo-fi music in improving students' concentration in physics learning. The hypothesis proposed that "the use of low-fidelity (lo-fi) music affects students' learning concentration." However, results from the *independent t-test* showed no significant difference between the experimental and control groups. This finding indicates that lo-fi music did not enhance students' learning concentration in physics.

These results align with previous research by Lehmann (2017), which found that background music had neither a positive nor negative effect on memory performance. This suggests that background music may not significantly influence cognitive performance, possibly due to limitations in working memory capacity when processing tasks alongside background sounds.

The findings are further supported by Li and Hu (2020), who noted that the effects of music on learning vary depending on the type of music, task complexity, and individual learner characteristics. During this study, some students reported feeling distracted because the music style was unfamiliar, while others felt relaxed and more focused. This indicates that while music can sometimes improve focus, it can also interfere with learning depending on personal preference and familiarity.

Although lo-fi music did not significantly improve concentration, the experimental group achieved a slightly higher average score (89.4) than the control group (87.86). In the experimental group, 6% of students achieved *very high* concentration, 83% *high*, and 11% *moderate*. In the control group, 80% were in the *high* category and 20% *moderate*. No students fell into the *low* category in either group.

All data were analyzed using SPSS for Windows version 26.0. The normality and homogeneity tests confirmed that the data were normally distributed and homogeneous. The

independent t-test revealed a significance value (2-tailed) of 0.444 (> 0.05), meaning there was no statistically significant difference between groups. Thus, lo-fi music neither increased nor decreased students' concentration levels during physics learning.

Previous studies on music and learning have produced mixed results. Bird (2017), for example, found that instrumental modern music familiar to listeners improved reading comprehension. However, unlike Bird's study, the current research used unfamiliar lo-fi instrumental tracks, which may explain the lack of significant impact. It is possible that students were not accustomed to listening to lo-fi music during lessons, or that the unfamiliarity of the genre reduced its effectiveness. Therefore, it can be concluded that lo-fi music had no significant effect on students' learning concentration in this context.

Conclusion

Based on the data analysis, it can be concluded that the use of lo-fi music does not have a significant effect on students' learning concentration. The average score of students who studied with lo-fi music was slightly higher than those who did not. The experimental class obtained a mean score of M = 89.4; SD = 8.819, with 2 students (6%) in the very high concentration category, 29 students (83%) in the high category, and 4 students (11%) in the moderate category. Meanwhile, the control class, which did not use lo-fi music, achieved a mean score of M = 87.86; SD = 7.93, with 28 students (80%) in the high concentration category and 7 students (20%) in the moderate category. No students in either group fell into the low concentration category, and there were no students with very high concentration in the control class. In summary, the use of low-fidelity (lo-fi) music does not have a significant impact on the learning concentration of Grade XI MIPA students in physics subjects at SMAN 1 Dramaga, Bogor.

Based on these findings, students may choose whether or not to use lo-fi music while studying, according to their individual preferences. Future researchers are encouraged to consider more specific student characteristics, such as personality types and music preferences. It is also recommended to control environmental conditions more strictly during the experimental process and to measure students' concentration levels before the intervention to strengthen the validity of future research results.

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