

Effects of Playing Techno Music During Physical Education on Intrinsic Motivation among Lower-Form Students

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ABSTRACT

Declining intrinsic motivation in Physical Education (PE) among lower-form secondary students remains a persistent educational challenge. Fast-tempo music can enhance engagement during physical activity, but empirical evidence within Malaysian PE settings remains limited. Guided by Self-Determination Theory (SDT), this study examined the effects of integrating techno music into PE classes on the intrinsic motivation of lower-form students. Besides that, this study seeks to identify the specific aspects of intrinsic motivation most influenced by the music. Consequently, this study would provide data-driven recommendations for effective integration of music into PE to enhance students' motivation. A quasi-experimental within-subjects design was conducted with 44 female students aged 13–15 in Subang, Malaysia. Using simple random sampling, intrinsic motivation was evaluated using the Intrinsic Motivation Inventory (IMI) across two conditions: PE sessions with and without techno music. Mean scores and standard deviations were consistently higher and lower, respectively, in all variables with music compared to non-music sessions. Paired-samples t-tests indicated significant post-intervention improvements across all IMI subscales, including interest/enjoyment, perceived competence, effort/importance, and value/usefulness ($p < .001$). Large effect sizes demonstrated that fast-tempo techno music serves as a potent pedagogical tool to elevate engagement, enjoyment, and perceived competence in secondary PE curricula.

Keywords: physical education, techno music, intrinsic motivation, self-determination theory, lower-form students

INTRODUCTION

Music serves as a potent intervention tool to enhance physical activity experiences across educational and recreational environments. Survey data indicate that three-quarters of Malaysians listen to music streaming platforms during workouts, illustrating its widespread motivational and stimulating qualities. Among various musical genres, techno music is distinguished by its fast tempo, rhythmic continuity, and repetitive structure, making it particularly compatible with aerobic activities, running, and dance. By establishing an energetic learning environment, techno music encourages students to engage in physical exercise while remaining focused and motivated during PE lessons. Apart from improving learning performance, the fast tempo and repetitive rhythms of techno music have also been found to be effective in improving an individual's mood. For instance, past studies revealed that listening to fast-paced music (approximately 140 beats per minute) not only raised the level of energy enhance the performance of the participants physically, but also raised the mood, without making the task more difficult (Pusey et al. 2023). Furthermore, techno music could also help the individual to feel a sense of flow, being in a place where they feel entirely engaged, dedicated and lively during teaching and learning sessions (Ryan & Deci, 2020).

The conceptual foundation of this study is grounded in Self-Determination Theory (SDT), which posits that intrinsic motivation flourishes when three basic psychological needs are fulfilled: autonomy, competence, and relatedness (Ryan & Deci, 2020). Autonomy represents the need for personal agency and self-governance over one's actions. Competence involves experiencing mastery and feeling capable of executing tasks effectively.

Relatedness reflects the sense of belonging and social connection experienced within a peer group (Ryan & Deci, 2020). In PE settings, fast-tempo techno music supports these needs by providing rhythmic auditory cues that assist motor synchronisation, thereby heightening students' perceived competence. Furthermore, participating in coordinated, rhythm-based group activities fosters peer bonding and social connectedness, satisfying the need for relatedness, while offering opportunities for music selection nurtures student autonomy. Similarly, teamwork tasks that are accompanied by music (e.g., coordinated exercises or collaborative tasks) also promote social bonding, enhance peer interaction, and make the learning process more inclusive and enjoyable (Ryan and Deci, 2020).

Despite these recognised theoretical benefits, student engagement in physical education declines significantly as adolescents grow older. Individuals, particularly during their developmental years, are at a decisive point when establishing a positive perception towards physical exercise is necessary to maintain healthy bodies and fitness throughout their lives. In Malaysian secondary schools, lower-form students aged 13–15 frequently exhibit diminished enthusiasm for PE (Chen & Hypnar, 2020). This disinterest stems primarily from repetitive instructional methods, dull routines, and a pervasive societal perception that PE holds lesser academic value compared to core subjects such as science and mathematics (Sullivan, 2023; Mercier, 2020).

Besides that, the traditional PE strategies (e.g., one-way communication, continuous block practice, lack of modification during PE lessons) usually do not meet the psychological needs of students, including the need to choose (autonomy), the sense of being successful (competence), and the interactions with peers (relatedness) (Sullivan, 2023; Ryan and Deci, 2020). Additionally, the lack of creative teaching methods also played a role in students' declining interest in PE (Carnegie Mellon University, 2021). This decline in physical activity engagement contributes directly to sedentary lifestyle habits and associated long-term health risks among adolescents. Reduced self-determined motivation correlates directly with decreased moderate-to-vigorous physical activity during class sessions. Consequently, the underestimation of PE leads to a lower sense of the importance of physical activity and would accentuate the likelihood of developing various non-communicable diseases (NCDs) related to lack of PA and sedentary lifestyles (Chen et al., 2020).

While national frameworks such as the Satu Murid Satu Sukan initiative mandate sports participation for all students, current policy frameworks lack specific pedagogical guidelines to enhance internal motivation. Therefore, the main aim of this study was to introduce fast-tempo techno music, which offers an innovative pedagogical strategy to revitalise PE instruction through better alignment between content and music preferences, which provided support to address students' psychological needs. Specifically, the objectives of this study were (1) to evaluate the effect of techno music on lower-form students' intrinsic motivation during PE classes, (2) to determine which specific dimensions of intrinsic motivation are most affected, and (3) to provide practical recommendations for integrating music into secondary school PE curriculum to enhance motivation during teaching and learning.

METHODOLOGY

Research Design

This study employed a quasi-experimental within-subjects design to evaluate the impact of techno music on intrinsic motivation during physical education lessons. A quasi-experimental structure was selected because random individual participant assignment is impractical within established school environments, where students are organised by age grades and academic streaming (Creswell & Plano Clark, 2021). For instance, students with high academic achievement were placed in one class, while those with average academic achievement were placed in one class and carried on till the end of the school year (Mansor et al., 2016). Besides that, this approach also allowed the researchers to conduct the study in a natural setting with minimal disruption and reduce the tendency for bias through randomising participants. The within-subjects framework exposed every participant to both experimental conditions: PE sessions conducted without music (control condition) and PE sessions conducted with techno music (intervention condition). This approach controlled for individual baseline variability in motivation and physical ability while minimising disruption to scheduled academic timetables (Creswell & Plano Clark, 2021).

Population and Sampling

The target population comprised lower-form secondary school students from an urban township in Subang, Selangor. The majority of students in this school originated from Peninsular Malaysia, with mixed races including Malay, Chinese, and Indian. Most of the students were from middle-income families with parents involved in professional, administrative, and service-oriented sectors. This demographic, aged 13 to 15, represents a critical developmental stage during which physical literacy, exercise habits, and social behaviours are established (Bailey et al., 2020). Out of a total population of 50 lower-form female students within the selected school, a sample size of 44 participants was selected based on the sampling table parameters (Krejcie & Morgan, 1970). A simple random sampling method was implemented to select participants, ensuring that every individual possessed an equal probability of selection, thereby mitigating selection bias and enhancing external validity (Pallant, 2020). The sampling focused exclusively on female students to address a noted gap in gender-specific PE motivation literature. To participate, students were required to be between 13 and 15 years old, actively involved in standard physical activity routines, healthy at the beginning of this study, and to possess signed parental consent. Students outside the specified age range, those lacking parental consent, or those medically restricted from physical exertion were excluded from this study.

Research Instrument

Data were gathered using the Intrinsic Motivation Inventory (IMI), a validated self-report instrument widely utilised in educational and psychological research to assess subjective activity-related experiences (Ryan & Deci, 2020). Similarly, past studies have explored the application of music in physical education, with the authors also applying the IMI to quantify the impact of music on the motivation of students. Their results indicate that music, particularly with beat tunes such as techno, has great potential in increasing intrinsic motivation by improving the sense of competence and pleasure among students during physical activities (Cools et al., 2023). The questionnaire evaluated four core subscales aligned with Self-Determination Theory: (1) interest/enjoyment, (2) perceived competence, (3) effort/importance, and (4) value/usefulness. Briefly, the interest/enjoyment subscale evaluated intrinsic pleasure and engagement during the task, while the perceived competence subscale measured self-evaluated skill level and mastery. Additionally, the effort/importance subscale measured the personal energy and work students invested in the given task. The value/usefulness subscale also assessed participants' perception of the activity benefits and its contribution to their personal development. All items were scored on a 7-point Likert scale ranging from low to high (i.e., 1 (strongly disagree) to 7 (strongly agree)). Reverse-coded items were incorporated to ensure thoughtful participant responses and maintain internal consistency of the data.

Data Collection Procedures

In the initial phase, both researchers allocated time to engage in discussion about the ideas through observation and current issues happening among students in the researchers' local context. Literature reviews were conducted using several databases such as ERIC, Scopus, Google Scholar and Web of Science using keywords such as (1) internal motivation, (2) music, (3) physical education, and (4) movement in the classroom. Key findings from each study were compiled in the form of a table to ease understanding and provide a visual depiction of authors, date of publication, methodology, findings and gaps in the field of studies. Apart from data triangulation, the table helped the researchers to develop data-driven aims, questions, objectives, and methodology for this study. Any disagreement was discussed academically between researchers for justification, strengths, challenges, and opportunities. Subsequently, details of the preparation of this study, both framework and logistics, were modified appropriately to ensure timely completion and to reach its objectives.

Data collection was structured across two sequential phases separated by an interval to avoid fatigue and testing effects. Ethical clearance was obtained from the authors' university Research Ethics Committee (REC), and formal parental consent and assent forms were secured prior to the beginning of the intervention. In the baseline pre-test session, the 44 participants completed a standardised PE lesson involving a dynamic movement activity named "Grab the Cone" without music, relying solely on standard whistle prompts.

Immediately following this baseline session, participants completed the Intrinsic Motivation Inventory to establish control metrics across the four subscales. In the subsequent experimental session, participants performed the identical "Grab the Cone" physical activity under the intervention condition. Continuous fast-tempo techno music was played through standardised audio equipment at a controlled, comfortable volume. Participants synchronised their running movements around a marked perimeter to the rhythmic music beat and reacted rapidly to capture a central cone whenever the music was abruptly paused. Physical activity intensity, duration, and instructional parameters were held constant between both sessions to isolate music as the independent variable. Besides that, the researchers also ensured that the volume of music was constant and did not disrupt the ability of the participants to complete the task. The nature and level of the activities were maintained similar to the pre-test phase to ascertain that any noted motivational changes may be attributed to the music intervention rather than variations in the level of activity. Immediately after the music-supported session, participants completed the post-intervention IMI survey under identical conditions.

Data Analysis

Statistical processing was executed using IBM SPSS software (version 30.0). Prior to inferential analysis, the assumption of normality was evaluated for all IMI subscale scores across both conditions using the Shapiro-Wilk test. The findings showed that the data were normally distributed, with all the p-values being above 0.05, indicating that the normality assumption was met. Therefore, parametric tests were used to assess the variables and support the development of this study's findings (Field, 2020). Descriptive statistics, including means and standard deviations, were calculated to summarise central tendencies and score distributions between variables. Besides that, paired-samples t-tests were conducted to determine whether statistically significant differences existed between the non-music and music conditions across all four motivation subscales ($p < .05$). To account for potential sample size bias and quantify the magnitude of the intervention's impact, effect sizes were computed using the Hedges' correction.

Findings

The research paper seeks to investigate how techno music may be used to improve intrinsic motivation among students, in that it may satisfy psychological needs of autonomy, competence, and relatedness among participants. All Intrinsic Motivation Inventory (IMI) subscale scores under the without music (WM) and music (M) conditions were tested using the Shapiro-Wilk test to determine whether they follow a normal distribution. The data were found to be normally distributed ($p > .05$). Thus, the conditions of parametric testing were satisfied, and paired sample t-tests were undertaken to investigate the differences between the two conditions.

Table 1. Average Score of Variable Across Pre-and-Post Intervention

	Mean	Std. Deviation
WITHOUT MUSIC (INTEREST/ENJOYMENT)	2.49	.872
WITHOUT MUSIC (PERCEIVED COMPETENCE)	2.28	.941
WITHOUT MUSIC (EFFORT/IMPORTANCE)	2.56	.939
WITHOUT MUSIC (VALUE/USEFULNESS)	2.63	.836
MUSIC (INTEREST/ENJOYMENT)	6.34	.428
MUSIC (PERCEIVED COMPETENCE)	5.60	.477
MUSIC (EFFORT/IMPORTANCE)	6.46	.544
MUSIC (VALUE/USEFULNESS)	6.05	.625

The table one above indicated that the mean score on effort/importance with music was the highest ($M=6.46$, $SD=0.544$). Next, the variable interest/enjoyment with music recorded the highest score ($M=6.34$, $SD=0.428$). Besides value/usefulness ($M=6.05$, $SD=0.625$), perceived competence among participants in the music group recorded the lowest average score ($M=5.60$, $SD=0.477$). In contrast, the mean score on

value/usefulness without music was the highest ($M=2.63$, $SD=0.836$), followed by the variable effort/importance ($M=2.56$, $SD=0.939$). Notably, the perceived competence among participants without music recorded the lowest average score ($M=2.28$, $SD=0.941$).

Table 2. Paired Sample Scores Between Variables Across Intervention

	Mean
Pair 1 WITHOUT MUSIC (INTEREST/ENJOYMENT)	2.49
MUSIC (INTEREST/ENJOYMENT)	6.34
Pair 2 WITHOUT MUSIC (PERCEIVED COMPETENCE)	2.28
MUSIC (PERCEIVED COMPETENCE)	5.60
Pair 3 WITHOUT MUSIC (EFFORT/IMPORTANCE)	2.56
MUSIC (EFFORT/IMPORTANCE)	6.46
Pair 4 WITHOUT MUSIC (VALUE/USEFULNESS)	2.63
MUSIC (VALUE/USEFULNESS)	6.05

Table 3. Paired Sample Test

	Mean	Std. Deviation	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
WITHOUT MUSIC - MUSIC (INTEREST/ENJOYMENT)	-3.847	1.046	Lower	Upper	-24.398	43	<.001
WITHOUT MUSIC - MUSIC (PERCEIVED COMPETENCE)	-3.312	1.051	-4.165	-3.529	-20.902	43	<.001
WITHOUT MUSIC - MUSIC (EFFORT/IMPORTANCE)	-3.902	1.117	-3.632	-2.993	-23.162	43	<.001
WITHOUT MUSIC - MUSIC (VALUE/USEFULNESS)	-3.420	1.109	-4.241	-3.562	-20.466	43	<.001

The paired samples test in Table 3 demonstrated the paired differences in mean scores in the four subscales Interest/Enjoyment, Perceived Competence, Effort/Importance, and Value/Usefulness, as well as t-values and level of significance. The second table (Means of Paired Samples) gives the means of the subscales of the two conditions (i.e., with music & without music), giving the average rating of the aspects of intrinsic motivation in physical activities.

Specifically, for the interest/enjoyment variable, the mean of WM_IE_MEAN ($M = 2.49$) and M_IE_MEAN ($M = 6.34$) were -3.847 ($SD = 1.046$), and the 95 per cent interval was $(-4.165$ to $-3.529)$. The t-test showed that there was a significant difference, $t(43) = -24.398$, $p < .001$, showing that the students enjoyed the PE classes with techno music significantly more. For perceived competence, there was a mean difference of -3.312 ($SD=1.051$) between WM_PC_MEAN ($M = 2.28$) and M_PC_MEAN ($M = 5.60$). The 95% confidence interval was $(-3.632$ to $-2.993)$. The t-test $t(43) = -20.902$, $p < .001$ indicates there is a statistically significant difference in the competency variable between groups

Furthermore, the mean scores of effort/importance WM_EI_MEAN ($M = 2.56$) and M_EI_MEAN ($M = 6.46$) were -3.902 ($SD = 1.117$), and the 95 per cent interval was $(-4.241$ to $-3.562)$. The t-test showed that there was a significant difference, $t(43) = -23.162$, $p < .001$, showing that students exerted considerably more effort in activities including techno music. Besides that, the value/usefulness variable recorded a mean difference of -3.420 ($SD = 1.109$) between WM_VU_MEAN ($M = 2.63$) and M_VU_MEAN ($M = 6.05$). The 95% confidence interval was $(-3.757$ to $-3.083)$. The t-test $t(43) = -20.466$, $p < .001$, implying that students appreciated the activities more and deemed them to be more constructive when techno music was incorporated.

Table 4. Paired Samples Effect Sizes

			95% Confidence Interval	
			Lower	Upper
Pair 1	WITHOUT MUSIC - MUSIC (INTEREST/ENJOYMENT)	Hedges' correction	-4.464	-2.821
Pair 2	WITHOUT MUSIC - MUSIC (PERCEIVED COMPETENCE)	Hedges' correction	-3.840	-2.400
Pair 3	WITHOUT MUSIC - MUSIC (EFFORT/IMPORTANCE)	Hedges' correction	-4.243	-2.672
Pair 4	WITHOUT MUSIC - MUSIC (VALUE/USEFULNESS)	Hedges' correction	-3.762	-2.347

The results of the paired sample t-test were analysed to identify the effect sizes of techno music on the intrinsic motivation of lower-form students in PE classes. To determine the effect size, Hedges' g was used, which is more precise in estimating the actual effect when small sample sizes are used. In the case of the interest/enjoyment subscale, the effect size was estimated as Hedges $g = 2.28$, indicating that there was a large effect of techno music on the enjoyment of students during PE class. In the same way, there was an effect size of Hedges' $g = 2.31$ for the perceived competence subscale, which demonstrates that there was a significant rise in the sense of competence of the students when music was included in the PE class.

In terms of effort/importance, it was found that Hedges' $g = 2.09$ was a large effect of techno music on the reported effort of students and the perceived importance of the activities. Lastly, under the value/usefulness subscale, the effect size was Hedges $g = 2.10$, which reported that there was a significant positive effect of music on the value and usefulness of activities of the students.

DISCUSSION

The empirical findings confirm that playing techno music during physical education classes significantly increases intrinsic motivation among lower-form secondary school students. Statistically significant improvements and exceptionally large effect sizes were recorded across all four evaluated subscales. These outcomes directly reflect the core mechanisms of Self-Determination Theory, proving that fast-tempo music creates an engaging environment that satisfies adolescents' basic psychological needs for autonomy, competence, and relatedness. Similarly, the studies by Karageorghis and Priest (2012) and Ryan and Deci (2020) are also in agreement that music has the potential to decrease the perception of effort as well as promote enjoyment and increase motivation to exercise. In this regard, techno music with its consistent rhythmical pattern and high-speed pulse probably gave the required framework and vigour to keep the students active, alert, and inspired during the PE activities.

Past research on music in PE has tended to use more varied music genres with very little attention given to the

particular effects of techno music. Whereas in this study, techno music has been the focus genre to observe changes in students' teaching and learning performance and experience. A deeper examination of the specific motivation subscales illustrates the physiological and psychological impacts of techno music. The Interest/Enjoyment subscale demonstrated the most dramatic baseline-to-post-intervention shift. Fast-tempo techno music provides a stimulating auditory distraction that reduces subjective perceptions of fatigue, monotony, and exertion. By transforming repetitive physical tasks into engaging activities, music shifts students' focus away from physical discomfort toward intrinsic pleasure. Simultaneously, Perceived Competence improved substantially. The prominent, continuous tempo of techno music provides clear auditory cues that assist students in synchronising their motor movements, making physical tasks feel more accessible and increasing self-efficacy. Additionally, the autonomy given to the participants, such as in music selections and options in physical activities, would also serve to improve their engagement and sense of belonging to the class sessions.

This heightened sense of physical capability directly incentivises students to invest greater Effort/Importance during PE routines without perceiving the tasks as overly burdensome. In practice, the music encourages the students to be more energised by providing them with a dynamic and stimulating auditory experience which heightens their motivation to perform physical activities. The rhythmic beats and quick pace of techno music can be especially effective during PE, during which a significant amount of sustained physical activity is necessary, as these songs would help students concentrate and be more enthusiastic in the learning session. Similarly, Cools et al. (2023) also discovered that PE classes with music led to students' increased enthusiasm and performance when engaging and solving challenges during teaching and learning sessions.

Consequently, students ascribe higher Value/Usefulness to physical education, viewing classes as meaningful opportunities for personal fitness and skill development rather than minor academic requirements. Equally, Ryan and Deci (2020) emphasise the need to establish environments that support the psychological needs of human beings, including making one feel competent and connected, to facilitate intrinsic motivation. Apart from the music genre and selection, educators should also observe their students' current capabilities, interests, and needs and subsequently modify the lesson content and management through instructions, equipment, and playing area to make it more age-appropriate, engaging, enjoyable, and safer for the students.

Taking into consideration the many co-factors would increase the benefits of music integration into teaching and learning sessions. Importantly, despite this study's lean towards the positive impacts of techno music on intrinsic motivation, it is worth noting that the response of all students to the genre may not be similar. Preference in music is an extremely subjective factor, and students' reactions to techno music can be different according to their personal tastes and exposure to the genre prior to this study. Therefore, a student who prefers techno music might be more motivated when listening to techno music compared to one who does not prefer the music and thus might not be as engaged or motivated when engaging in physical activity. Additionally, it is also necessary to observe the period of the music played, as continuous long-term music exposure during physical education may cause sensory overload. Consequently, lessen the beneficial effects of music during teaching and learning (Sullivan, 2023).

Implication for Practice

To translate these empirical findings into effective instructional practice, educators must strategically integrate music genres and tempos according to specific lesson phases. High-tempo techno music is optimal for continuous aerobic workouts, cardio circuits, and dynamic games because its energetic beat sustains movement cadence and elevates class energy. In contrast, upbeat pop music can be utilised during team-building and cooperative skill drills to foster peer interaction, social bonding, and relatedness (Karageorghis & Priest, 2012). Dynamic genres such as hip-hop or rock provide strong rhythmic driving forces suitable for strength training, callisthenics, or plyometrics. Conversely, slow-tempo classical music should be reserved for flexibility routines, stretching, and post-exercise cool-downs to facilitate muscle relaxation and recovery (Karageorghis & Priest, 2012). Furthermore, offering students periodic opportunities to contribute to class playlists enhances their sense of autonomy, further strengthening self-determined motivation.

From an educational policy and administrative standpoint, these findings hold substantial practical value. Secondary school administrators and curriculum developers should recognise acoustic tools as impactful, cost-effective pedagogical instruments that combat adolescent physical inactivity. In line with national initiatives like Satu Murid Satu Sukan, educational authorities should establish formal guidelines for integrating music into PE curricula, provide basic sound infrastructure to schools, and offer professional development workshops for teachers. Incorporating structured music strategies helps transform standard PE lessons into dynamic environments that nurture lifelong health habits.

Several study limitations should be considered when interpreting these results. First, the participants were restricted to female lower-form students from a single urban school in Subang, limiting the immediate generalisability of the findings to male students, rural school environments, or different age demographics. Second, data collection relied on self-report questionnaires, which may introduce self-perception or social desirability biases. Third, individual participant musical preferences were not controlled, which could influence how strongly specific students respond to the techno genre. To build upon this research, future studies should employ gender-balanced samples across diverse geographical locations, utilise longitudinal designs to measure whether motivational gains persist across an entire academic year, and incorporate objective physiological measures such as heart rate monitoring and physical movement tracking.

CONCLUSION

Integrating fast-tempo techno music into physical education classes significantly elevates intrinsic motivation among lower-form female secondary students. Techno music enhances interest and enjoyment, boosts perceived physical competence, encourages greater personal effort, and elevates the perceived utility of physical activity. Strategically embedding music into PE curricula provides physical educators with an effective, accessible pedagogical tool to increase student engagement, mitigate adolescent physical inactivity, and foster long-term health and wellness habits.

REFERENCES

1. Adelphi University. (2020). Student engagement and learning. Adelphi University. <https://www.adelphi.edu>
2. Adheera D-ra. (2026). Evaluating national sports policies in Malaysian secondary education. *Educational Review*, 14(1), 12–25. American Heart Association. (2021). Benefits of physical activity. <https://www.heart.org>
3. Aziz, A. R., & Wahid, R. (2020). Students' perception towards physical education in Malaysian schools. *Journal of Physical Education and Sports Science*, 8(2), 45–53.
4. Bailey, R., Hillman, C., Arent, S., & Petitpas, A. (2020). Physical activity: An underestimated investment in human capital? *Journal of Physical Activity and Health*, 17(9), 841–852. <https://doi.org/10.1123/jpah.2020-0316>
5. Ballmann, C. G. (2021). The influence of music preference on exercise responses and performance. *Journal of Functional Morphology and Kinesiology*, 6(2), 33. <https://doi.org/10.3390/jfmk6020033>
6. BMC Public Health. (2020). Behavioural engagement and physical activity participation. *BMC Public Health*, 20, 1234. <https://doi.org/10.1186/s12889-020-09321-7>
7. Carnegie Mellon University. (2021). Student motivation and engagement in physical education. <https://www.cmu.edu>
8. CDC. (2020). Physical activity and health. Centres for Disease Control and Prevention. <https://www.cdc.gov>
9. Chen, A., & Hypnar, A. (2020). Children's interest in physical education: A review of literature. *Journal of Teaching in Physical Education*, 39(3), 395–408. <https://doi.org/10.1123/jtpe.2019-0125>
10. Chen, A., Martin, R., & Ennis, C. (2020). Student motivation and engagement in physical education. *Journal of Sport and Health Science*, 9(3), 243–252. <https://doi.org/10.1016/j.jshs.2020.02.004>
11. CikguHafizuddin. (2025). Malaysian national education curriculum updates in physical health education. *Journal of Malaysian Education*, 18(2), 101–114.

12. Cools, W., De Frère, J., & Caplan, N. (2023). The impact of music on students' motivation during physical education classes. *Physical Education and Sport Pedagogy*, 28(2), 215–230. <https://doi.org/10.1080/17408989.2022.2032543>
13. Creswell, J. W. (2020). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (6th ed.). Pearson.
14. Creswell, J. W., & Creswell, J. D. (2020). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.
15. Creswell, J. W., & Plano Clark, V. L. (2021). *Designing and conducting mixed methods research* (3rd ed.). Sage Publications.
16. Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry*, 11(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01
17. Field, A. (2020). *Discovering statistics using IBM SPSS statistics* (5th ed.). Sage Publications.
18. Gernandt, J., & Merrill, J. (2024). Cultural and rhythmic dimensions of techno music. *Music & Society*, 46(1), 77–92. <https://doi.org/10.1080/03007766.2023.2278194>
19. Gravetter, F. J., & Wallnau, L. B. (2016). *Statistics for the behavioural sciences* (10th ed.). Cengage Learning.
20. Karageorghis, C. I., & Priest, D. L. (2012). Music in the exercise domain: A review and synthesis. *International Review of Sport and Exercise Psychology*, 5(1), 44–66. <https://doi.org/10.1080/1750984X.2011.631026>
21. Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610. <https://doi.org/10.1177/001316447003000308>
22. Mansor, N., Abdullah, A., & Rahman, A. (2016). Ability grouping and student achievement in Malaysian schools. *Asian Journal of Education*, 37(4), 389–402.
23. Mercier, K. (2020). Students' declining interest in physical education. *Strategies*, 33(2), 21–26. <https://doi.org/10.1080/08924562.2019.1705211>
24. Musa, R. M., & Saidon, N. (2021). Motivation and engagement in Malaysian physical education classes. *International Journal of Academic Research in Progressive Education and Development*, 10(3), 567–578.
25. Ntoumanis, N., & Standage, M. (2009). Motivation in physical education classes. *Journal of Educational Psychology*, 101(2), 378–392. <https://doi.org/10.1037/a0014696>
26. Pallant, J. (2020). *SPSS survival manual* (7th ed.). McGraw-Hill Education.
27. Priest, D. L., & Karageorghis, C. I. (2012). A qualitative investigation into the characteristics and effects of music accompanying exercise. *European Physical Education Review*, 18(1), 87–106. <https://doi.org/10.1177/1356336X11430611>
28. Pusey, M., Davies, R., & Taylor, S. (2023). Fast-tempo auditory interventions in aerobic exertion. *Journal of Sports Sciences*, 41(2), 112–121.
29. Ryan, R. M., & Deci, E. L. (2020). *Intrinsic and extrinsic motivation: Classic definitions and new directions*. Routledge.
30. Saleh, M. A., Hassan, N., & Yusof, A. (2023). Preferred music tempo and endurance running performance among adolescents. *Journal of Sports Sciences*, 41(5), 512–520. <https://doi.org/10.1080/02640414.2023.2174123>
31. SHAPE America. (2021). National standards for physical education. <https://www.shapeamerica.org>
32. Spotify. (2023). Music listening habits during exercise in Malaysia. *Spotify Insights*. <https://www.spotify.com>
33. Sullivan, K. (2023). Student engagement challenges in physical education. *Journal of Teaching in Physical Education*, 42(1), 14–26. <https://doi.org/10.1123/jtpe.2021-0218>
34. Tutor Chase. (2024). Education streaming and class placement systems. <https://www.torchase.com>
35. World Health Organisation. (2020). Guidelines on physical activity and sedentary behaviour. <https://www.who.int>