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## EFFECT OF INSTRUMENTAL MUSIC ON STUDENTS' PERFORMANCE IN PHYSICS EXPERIMENTS IN RONGO SUB- COUNTY, KENYA.

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### ABSTRACT

*Listening to music while performing other tasks is a common feature in multi-tasking. Instrumental music is known to have beneficial effects to subjects while multi-tasking. This paper explores the performance of students in Physics experiments while Instrumental music is playing in the background. Quasi- experimental study design was used in this study. A control group did three experiments without Instrumental music playing in the background while an Experimental group did the same three experiments while soothing instrumental music was playing in the background.*

*The study targeted 987 Form 3 physics students in Rongo Sub- County. Purposive sampling was used to select one school that ha a relatively large population of students taking Physics. All Form 3 students in the sampled school formed the sample of 93 took part in this study. Data was collected using instrumental music (soothing relaxation) performance tests, a questionnaire and an observation schedule. The study registered mixed results in terms of performance of the two groups.*

*The study found no significant difference in performance of students who perform the whole experiment while instrumental music is playing in the background and those who do not. The study found no significant difference in performance of students who analysed trial data while Instrumental music is playing in the background and those who did in silence.*

*However, there was significant difference in performance of the groups when the experimental group collected data while instrumental music played in the background with the experimental group performing better than the control group. The study recommends use of instrumental music in a controlled manner and that more research need to be done to establish the effect of instrumental music in other science subjects*

**Keywords:** Physics experiments, physics performance, Instrumental music, Multi-tasking

### INTRODUCTION

Physics is one of the STEM subjects taught in secondary school curriculum in Kenya. Physics is a key subject in attaining national industrial goals.

According to Muriithi, Odundo, Origa, and Gatumu (2013) for Kenya to achieve its technological and industrial goals, the achievement of students in Physics needs to improve especially since there is a growing demand for science educators to improve the learning of Physics for technological advancement.

Use of music in learning has proven to have multiple beneficial effects in the area of language teaching such as addressing multiple intelligences; reducing anxiety; increasing motivation; facilitating memory retention and establishing an effective learning environment (Daler, Umed, Dalia, Liliati, & Moomala, 2018). Listening to music while performing other tasks is a common feature of multitasking (Silasi-Mansat, 2017) and music has control of human psyche (Aristotle, 1995) and can therefore potentially motivate students to perform demanding academic activities such as physics experiments.

Demanding academic workload and frequent assessments are contributing factors to student's psychological distress (Weston, Gardner, & Yeung, 2017). There is therefore need to make physics experiments relaxing and enjoyable. Instrumental music is known to promote a calming effect and reduce stress and anxiety when multi-tasking (Lin, Vahidi, & Mosaed, 2018).

Lesiuk (2005) in Canada studied the impact of listening to music while engaged in complex cognitive tasks among software developers. The findings reported positive effect of music on work achievement and revealed the value of music listening for positive mood change and enhanced perception on design while working.

The study results indicated that quality of work was lowest with no music, while time-on-task was longest when music was removed. The study also concluded that 'the positive affect and quality-of-work were lowest with no music, while time-on-task was longest when music was removed. In the field of veterinary medicine, it was noticed students experienced elevated stress, anxiety and depression resulting in psychological changes (Killinger, Flanagan, Castine, & Howard, 2017). To avert these negative effects, psychoacoustic music was found to promote calming effects using simple and slow piano music (Lin et al., 2018).

Music is played in most operating rooms around the world both during surgeries and in between cases (Lin, Vahidi, & Mosaed, 2018). According to the study of Lin et al. (2018), most operating rooms around the world play music both during the surgeries and in between cases. The study found out that the turnover time was significantly faster in the fast music group versus the slow music group.

Playing Instrumental music during surgical operations greatly enhanced performance in surgical domains such as instrument handling, general task quality, turn over time and general time to task performance (Oomens, Victor, Kleinrensink, & Jeekel, 2019). In a study on the effect of music tempo on exercise achievement and heart rate among young adults, Thakare, Mehrotra, and Singh (2017) found out that the maximum heart rate achieved during exercise was significantly higher with music condition than without.

McCelland and Furnham (2016) study investigated the effect of background music on the cognitive achievement of musicians. Participants in the study who were trained musician completed puzzles in three conditions (silence, a different piece of music, own and other musical instruments). They found that musicians' achievement on cognitive tasks is more impaired when listening to music featuring their own respective instruments than when not and best in silence condition. In Hannah (2018) fourteen music students aged 18 or older worked on a sudoku puzzle in three conditions (silence, Instrumental music not containing one's primary instrument and Instrumental music containing sound of one's primary instrument).

Hannah (2018) revealed that students were able to complete the largest amount of the puzzles without background music and the least amount when music containing a primary instrument was used. In Dolegui (2013), thirty-two undergraduate participants were made to perform twenty arithmetic tests under three conditions (60 tests in total in silence, instrumental music and lyrical music conditions). Dolegui (2013) found out that scores in tasks performed in silence were significantly higher than scores in task performed with instrumental music playing in the background. Hars et al. (2014) looked at effect of music-based multitask training on cognition and mood in older adults. In the study one group of participants carried out multi tasks with instrumental music (Experimental group) while another group carried out multi tasks in silence (Control group) during which their achievement was measured.

Schwartz et al. (2017) did a literature review on effects of music on task achievement, engagement and behavior of 20 studies. In the study, eight studies were reviewed concerning music in relation to task achievement and task engagement and out of the eight studies, 6 reported beneficial effects of background music in relation to task achievement and task engagement.

As quoted in the study, “The studies reviewed above suggest that music can have a stimulating effect, increasing both task engagement and achievement across a variety of academic, vocational, and daily living tasks “(Schwartz et al., 2017, p.9). In Darwich (2016), there was no significant difference in achievement between students who solved puzzles in silence and students who solved puzzles while instrumental music is playing in the background. Even though the stamping task in Darwich (2016) only lasted 7 minutes unlike this study where the experimental tasks took about 40 minutes, similar result findings were posted as far as positive effect of music is concerned when one is engaged in repetitive tasks. Physics experiments involve a myriad of repetitive tasks of getting values and drawing of graphs, which no doubt takes a longer time (more than 7 minutes). Furthermore, a study by Levon (2011) also found out no significant difference in terms of recall information about an advert between participants that were shown the advert with no instrumental music and participants who were shown the same advert with instrumental music.

Despite these documented benefits of instrumental music while multi-tasking, the use of instrumental music in Kenyan secondary school experiments is uncommon. Given the positive impact of instrumental music in various fields of study, this paper

sought to find out the effect of instrumental music on student performance in physics experiments.

#### **RESEARCH OBJECTIVE AND HYPOTHESIS**

The study adopted the following objective and hypothesis:

To examine the effect of Instrumental music while performing experiments on academic achievement in Physics.

There is no significant difference in performance of students who perform experiments with instrumental music and those who do not.

#### **METHODOLOGY**

The study deployed Quasi- experimental research design. Purposive sampling was used to sample one school which had a relatively larger population of students taking Physics in Rongo Sub County. Sixty-two students formed the sample in this study. The student sample was then split into two groups; thirty-one students formed the control group while the other 31 students formed the experimental group. Both groups performed three different trials (experiments).

In all of the three trials, the control group performed the trials in silence without Music playing in the background. The experimental group performed all the three trials with instrumental music (‘Sunny Mornings’ from ‘Soothing Relaxation’ by Peder B. Helland) playing in the background.

Instrumental music was played at different stages during the trials. During the first trial, the experimental group performed the whole trial instrumental music. During the second trial, the experimental group collected data in silence but analysed the data with instrumental music playing in the background. During the third trial, the experimental group collected data with Instrumental music playing in the background but analysed the data in silence without instrumental music playing in the background. All the three trials performed by the groups were taken out of Kenya Literature of Bureau secondary Physics Book Three.

The experimental achievement tests were then marked and scores recorded. An observation schedule was used to find out if the learners would be distracted by the music or would show evidence of difficulty performing the experiments. Qualitative results were analysed thematically while Quantitative test results were then analysed using mean and ANOVA.

**RESULTS AND DISCUSSION**

The first and the second trials were out of 15 marks while the third trial was marked out of 20. Table 1 details the performances of the groups in the three trials.

**Table 1: Trial results**

Group	Experiment 1(/15)		Experiment 2(/15)		Experiment 3(/20)	
	Mea n	%	Mea n	%	Mea n	%
Control	7.84	52.27	4.90	32.67	9.87	49.35
Experime ntal	7.45	49.67	5.34	35.6	11.85	59.25

From Table 1, in first trial, it is evident that the control group only performed better than the experimental group on the first trial where the experimental group had performed the whole Physics trial with instrumental music. However, the difference in performance between the two groups for the first trial was not significant. Further analyzing Table 1, it is clear that the experimental group performed better in the second physics trial and in the third trial. The difference in achievement between the two groups for the second physics trail was also not significant. However, the difference in performance between the groups in the third physics trial was significant.

The findings of this study therefore do not support the findings of Padmasiri (2014) who found out that playing music in the background while the employees went about their garment factory work negatively impacted their work and led to more errors.

While the study of Padmasiri (2014) was limited to exploring effect of music on cognitive work for the large part and among adults, this study explored Instrumental music effect among teenagers when they do experiments which involve both cognitive and non- cognitive work and established a positive effect of instrumental music on task achievement which is a contrast to the findings of Padmasiri (2014).

Furthermore, in some instances like in the second and third trials the performance of the experimental group was better than the control group. The findings of this study on the effect of instrumental music while performing experiments is also in contrast with the study done by Dolegui (2013). which is contrary to the findings of this current study in regards to this objective. It is important to note that the mathematical operations done by the participants in the study of Dolegui (2013) were relatively simple and would be easy to solve especially for participants who had a stronger mathematical background regardless of whatever conditions were placed unlike this current study that tested participants on relatively difficult cognitive tasks.

Furthermore, even when the score in tasks performed in this study in silence were better (as displayed in trial 1) than tasks performed in music condition, the difference in achievement was not significant.

In most instances, scores in tasks performed under Instrumental music condition was better than scores in tasks performed in silence (as seen in trials 2 and 3).

As earlier stated, Physics experiments typically involve two stages; data collection and data analysis. Table 2 details the performance means of each group on each stage of the experiments.

**Table 2: Results of data stage and analysis stage of experiments**

Group	Trial 1		Trial 2		Trial 3	
	Data Collection	Data Analysis	Data Collection	Data Analysis	Data Collection	Data Analysis
Control	<b>21.9</b> <b>4</b>	<b>30.3</b> <b>3</b>	9.81	<b>22.8</b> <b>6</b>	32.0	17.8 5
Experimental	20.9 4	28.7 3	<b>13.0</b> <b>7</b>	22.5 3	<b>38.6</b> <b>5</b>	<b>20.6</b> ,

As revealed in Table 2, there are mixed results in performance when it comes to the different stages involved in Physics trials with the control group taking 6/12 and experimental group taking 6/12. Notably, data was collected with instrumental music in two trials (Trial 1 and 3) and in both instances the experimental group either performed significantly better (as displayed in Trial 3) or posted similar results as the control group. This finding agrees by the finding of Naveen et al. (2016).

In Naveen et al. (2016) a higher percentage of correct scores on a test were obtained by students who did a test while instrumental music was playing in the background (67%) than students who did the same test in silence (31%). This finding also agrees with the findings of Hars et al. (2014) as far as positive effects of instrumental music are concerned when one is working. Therefore, comparing the results of the two studies, instrumental music is positively received by participants of different age brackets in the age spectrum. In addition, in the study of Geethanjali et al. (2016) participants in instrumental music group identified more correct answers than participants in the silence group. Furthermore, the mean pulse rate of participants in Geethanjali et al. (2016) was significantly low while performing the tasks with Indian classical music than when performing the tasks in silence.

In Geethanjali et al. (2016) the achievement in tasks performed in the study were measured via computer generated activities while the performance in tasks in this current study were not computer based and yet similar findings were posted. During the study, we did not notice any significant difference in distraction levels or difficulty to perform the trials among all the groups.

All the groups more or less carried out the trials smoothly, calm and concentrating on the trials assigned at hand when collecting data. It does appear that instrumental music brought about a calming effect among the students during the experiments.

This mixed result is revealed in Table 3 when the performance of individual groups are further analysed.

**Table 3: Performance of Each Group in the Experiments**

Group Name	Type of Group	Trial 1		Trial 2		Trial 3	
		Data Collection	Data Analysis	Data Collection	Data Analysis	Data Collection	Data Analysis
F1	Experimental	23.33	29.03	10.0	22.0	36.8	25
F2	Experimental	19.57	30.47	17.07	24.87	38.35	24.31
F3	Control	27.2	34.33	13.33	23	33.75	18.45
T1	Experimental	16.67	26.67	11.65	20.09	40.4	15.0
T2	Experimental	26.67	26.67	11.72	22.87	39.76	17.15
T3	Control	19.455	25.40	6.145	22.695	29.71	17.18

As evidenced in Table 3, it is difficult to conclude conclusively which group is better in terms of achievement especially in Trial 1 and 2. However, the experimental groups seem to perform better in most of the stages for group F1, F2, F3 or T1, T2, T3.

The observation where experimental groups performed higher in most of the stages involved in trials aligns with the observation of Oomens et al. (2019) in terms of number of instances where beneficial effect of music is reported. According to Oomens et al. (2019), five out of nine studies reported beneficial effects of music on different surgical achievement domains including general task achievement.

One might argue that surgeries are done by doctors, nurses and clinicians with years of experience and therefore may not find it difficult doing repetitive tasks with or without music yet in this study high school students who do not have years of experience doing experiments recorded positive results in their achievement in Physics practical that no doubt involve repetitive tasks such as during collection of experimental data and drawing of graphs. This finding is also in agreement with the findings of Schwartz et al. (2017) and Darwich (2016) on task achievement.

Findings of this study did not agree with those of Hannah (2018), and McClland and Furnham (2016). It is important to point out that the contrast in findings of Hannah (2018) and McClland and Furnham (2016) with this current study finding was likely because of the nature of participants in the two studies aforementioned.

In McClland and Furnham (2016) and Hannah (2018), the participants were Instrumental music students or trained Instrumental musicians who likely suffered seductive details from the groove experience as a result of using Music containing their primary Instrument or a genre that they liked as opposed to this study where the participants were not music students. However, the difference in achievement in the three conditions was not significant.

The findings of this study seem to align with the findings done by Thakare, Mehrotra, and Singh (2017) in the field of sport science. In Thakare et al. (2017) athletes performed various exercises, some with music and others without music over a period of ten days. During the study, the heart rate and achievement of the athletes was measured. Thakare et al. (2017) established that participants exercised more with music than without music and the maximum heart rate during exercise with music was significantly higher than the maximum heart rate during exercise without music.

Therefore, in terms of achievement, whether its experimental achievement or physical exercise achievement, background music seems to positively affect achievement. This finding is also in agreement with the finding of Naveen et al. (2016).



In Naveen et al. (2016) a higher percentage of correct scores on a test were obtained by students who did a test while Instrumental music was playing in the background (67%) than students who did the same test in silence (31%). In Naveen et al. (2016), 200 medical students were asked why they studied or did not study with music and later subjected to tests while listening to preferred genre of music. Even though Naveen et al. (2016) never assigned quantitative values to time spent on listening to music while performing a task, this study varied time engaged in tasks by the participants while instrumental music is playing in the background and established similar results of positive effect of instrumental music on tasks achievement just as in Naveen et al. (2016).

In the study of Hars et al. (2014), participants aged 65 years and above showed increased cognition function and decreased anxiety when working with Instrumental music. As evidenced in Table 3, the experimental groups did not show extreme differences in their scores, contrary to findings of Shih et al. (2009) where students who listened to Music in an attention test in Taiwan showed extreme variation in their scores.

A Z-test was performed on the overall combined achievement of the control and experimental group to test the hypothesis that; there is no significant difference in

achievement of students who perform experiments with instrumental music and those who do not.  $H_0: \mu_1 = \mu_2$ . At  $\alpha=.05$  the critical Z value is 1.97, for Trial 1  $Z= .545$  which is less than 1.97. Since  $0.545 < 1.97$  the null hypothesis was retained hence there is no significant difference in achievement of students who perform the whole experiment with instrumental music and those who do not for Trial 1.

For Trial 2,  $Z= .800$ . Since  $0.800 < 1.97$  the null hypothesis was retained. There is no significant difference in performance of students who perform experiments with instrumental music and those who do not for Trial 2. For Trial 3,  $Z (2.86) > Z_c (1.97)$  2.86 so the null hypothesis was rejected. There is significant difference in performance of students who perform physics trials (experiments) with instrumental music and those who do not for Trial 3. From Trial 3 it can be implied that use of instrumental music in physics experiments during the data collection stage improves performance of students in Physics trials possibly because of their more relaxed mental state.

The students through the questionnaires were queried on their preference when it came to performing experiments. In this study 76.9% responded that they preferred to perform Physics experiments with instrumental music while 23.1% preferred to perform Physics experiments without instrumental music.

The above responses indicate that a large majority of students prefer to integrate instrumental music in the learning of Physics. A cross check of the participants papers during marking, to check on the visibility and clarity of both numeric and alphanumeric writings, did not show difference in visibility or clarity in the papers. Students in the two groups also handed in their test papers at random times regardless of group.

Lesiuk (2005) found out that time on task were lowest when music was removed, however in this study students who worked in silence condition and music condition handed in their works at the same rate. Pitman and Rajab (2019) also noted that 60.9% of undergraduate students in South Africa indicated that they could listen to music and write at the same without getting distracted which was a similar case for high school students who performed the experiments with instrumental music playing in the background. Hence when the study of Naveen et al. (2016) postulates the question of if this trend of studying with music could be justified as beneficial to the students in their academic achievements or not, based on the findings of this study, we answer in the affirmative; background music seems not to negatively affect task completion rate.

## **CONCLUSION AND RECOMMENDATIONS**

This study registered mixed results when it came to performing experiments with instrumental music. Notably there was significant difference in performance when the students collected data with instrumental music with the experimental group performing significantly better than the control group that did the trials in silence condition without instrumental music. It can therefore be inferred that use of instrumental music while performing physics experiments (trials) particularly during the data collection stage enhances academic performance in Physics.

Based on these findings, schools could explore the possibility of allowing the students to perform experiments with instrumental music. More studies need to be done to clarify the conditions under which students perform much better with background music.

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