

Enhancement of Gaming Experience and Performance through an Ergonomically Designed Console Chair

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Abstract

Posture has an important role in mobility, breathing, muscle efficiency, and injury prevention for any human activity, including console gaming. Proper posture allows players to minimize the work muscles needed to exert while playing, thus allowing them to play for longer durations of time without much discomfort. One of the key features of proper posture is correct positioning of the shoulder blades, which is affected by the position of the thoracic spine. This study involves the construction of an ergonomic console chair dedicated to a specific demographic in order to improve the posture and comfort that experience while playing, with its dimensions being based specifically on the average Filipino male workers body measurements. One design the researchers proposed incorporated an underarm support system meant to guide the shoulder blades into proper position, thus overall improving the user's posture. To further test the effects of using this ergonomic chair, it was compared to that of an ordinary non-ergonomic chair, in terms of its effects on the user's comfort and performance. Prior observation in a local gaming shop was done to study what posture related problems players experienced while playing. In addition, both a pre-experiment and a post-experiment survey were conducted to test the chair's effect on the user's comfort and experience. The experiment proper had participants play two gaming sessions on each chair, with the variable in question being the scores each player attained per session. After gathering all necessary data, various statistical tools were used to determine the chair's effectiveness. Based on the statistics, the ergonomic console chair has proved to be effective in improving a user's experience and performance.

Keywords

Posture, Ergonomic console chair, Experience, Performance

1. Introduction

Video games have earned a reputation over the years as a development of technological advances. Through different upgrades and optimizations, each game can bring its own, new level of entertainment. With this, there has been an increase in professional esports players and casual players alike, with some choosing to play on game consoles. But regardless of whether one plays for sport or for entertainment, the objective while playing a game usually remains the same: to win.

Posture has an important role in mobility, breathing, muscle efficiency, and injury prevention. Poor posture pressures muscles into working harder, increasing the risk for several musculoskeletal injuries. Proper posture, on the other hand, minimizes the work these muscles would need to exert while playing, which would then allow players to play for longer durations of time without feeling any discomfort. One of the key features of proper posture is correct positioning of the shoulder blades, which is affected by the position of the thoracic spine. After setting the thoracic spine, the shoulder blades should be appropriately positioned to minimize the risk of injury in the shoulders. There are 17 muscle attachments at the shoulder blade, which is a testament to how important its position is for physical health when sitting. Identifying the position of the shoulder blades and addressing the faults is important in improving one's posture while playing.

Most children and adolescents in the United States use computers and electronic games regularly, as reported in surveys and government statistics. Although use levels are not the same as for adults, computer users who are at risk of work-related upper extremity problems, children and adolescents' overall burden of computer and electronic device use are notable specifically on posture (Gillespie et al., n.d.). Game consoles, such as Sony's PlayStation 4 and Microsoft's Xbox One, are some of the electronic devices used by adolescents. This suggests that there is a need for players to improve on their posture, and one way to do so would be making use of an ergonomic chair.

2. Gaming Chair's Effect on Gaming Performance

According to an article by Smith (2018), a gaming chair is a modern advancement in the gaming world that has allowed players or gamers to prevent different injuries and also improve their performance. This is mainly because of the exceptional comfort that the gaming chair offers to its users, which allows them to assume proper posture while using it. The unique adjusting capabilities of the gaming chair ensures that the body is safe and comfortable. When the mind and body is free of excessive strain, the body is relaxed and in its natural positions, allows the gamers to improve their performance and achieve good results. Hence, a gaming chair is specifically suited to help the body function naturally as a person plays. In turn, the player would be able to improve their performance.

According to another article by Saban (2018), many believe that gaming chairs are the key to improving one's gaming performance because of its advantageous features. The three most common advantageous features that a gaming chair offers is adjustability, comfort and appearance. Adjustability allows the gamers to make the most out of their gaming chairs. Adjusting one's chair throughout the game will increase one's overall performance. Moreover, comfort enables the gamers to stay in their seat for long periods of time without experiencing discomfort. The most common reason why the performance of gamers starts to suffer is due to lack of comfort. Furthermore, appearance allows those gamers who stream their games online to make them look like a professional player, which eventually could lead to gaining more followers. This would eventually increase the player's performance because of their viewers. With this, the researchers would also use this information in justifying the results of the experimentation of the study.

3. Methodology

3.1. Construction of Prototype

An ergonomic chair was designed based on a survey and some related literature. Following the design of some other console chairs, the seat cushion will serve as the chair's base. This should be wide and thick enough to support the user, and stable enough to ensure that the chair does not move across the floor when used.

Connected to the base will be the chair's backrest. The entire backrest will be able to recline up to 20 degrees backwards. The backrest will be designed with two curves: the lumbar curve for the lower back, and the thoracic curve, which is located in what is commonly referred to as the upper back. This will be patterned after the Killian Ideal Spine Model.

On top of the backrest will be the neck support. This will be a separate piece of foam that will be attached with the use of adjustable vertical metal bars similar to those found in car seats. Aside from the chair's main parts that will be set into position, the chair will also possess some adjustable features. The chair will be composed mainly of two adjustable parts: the neck support and the arm support. Both may be adjusted vertically, but only the armrest may be tilted downward or upward. The overall framework of the chair was made from recycled materials; specifically, some recycled metal pipes and a used car seat. Original automotive and rebounded Uratex foam was used for the foaming of the ergonomic chair, and Nylex black German leather with platinum dotted red leather (synthetic) was used for the cover of the chair. A special mechanism was installed on the chair for the specialized arm rest. Construction of the chair took about a month.

Figure 3.1 shows the design of the proposed ergonomic console chair. The materials used by the manufacturer were Nylex Brand Black German leather with Platinum Dotted Red leather (synthetic) for the seat cover, and original automotive foam and rebounded Uratex foam for the foam padding.



Figure 3.1 Prototype Console Chair

3.2. Experiment Proper

To test the chair's effect on performance and experience, ten male participants who passed these qualifications were chosen to participate in the experiment: have experience in using a console, did not have any physical or mental disability during the duration of the experiment, and have prior experience in the game used for testing, Call of Duty: Black Ops 3.

Pre-experiment surveys were conducted to have a background on the participants and post-experiment surveys to gather their comments and opinions regarding the ergonomic chair.

The experiment took place in one of the researcher's condominium near the university. The five major components in the setup are the television, PlayStation 4, the non-ergonomic chair, the ergonomic chair and the aforementioned first-person shooter (FPS) game. The experiment is composed of two parts, wherein each respondent would sit on the non-ergonomic chair and on the ergonomic chair for an hour each.

Throughout the experiment, the researchers observed their change in posture over time; pictures of each respondent using the two chairs were documented to be used for data analysis.

In terms of the settings of the game, the game mode used was Team Deathmatch, with five members per team, the map used was Nuk3town, the duration of the game was 30 minutes, and the score limit per team was set to 1000 points. Since the game's maximum duration was only 30 minutes, the researchers had the respondents play two rounds in each chair, averaging their scores afterwards.

3.3. Data Analysis

With the following data that will be gathered from the experimentation and post-survey questionnaires, the researchers would use the following statistical methods: hypothesis testing, paired t-test, and regression. The hypothesis testing will be used on the scores that the participants will achieve from the two sessions of the non-ergonomic and ergonomic chairs in the experiment. Moreover, the paired t-test will be used on the questions that ask for a rating for a specific area on the ergonomic chair which is asked on the post-survey questionnaire. Furthermore, the regression will be used on the average scores of the participants in the two sessions of the non-ergonomic and ergonomic chairs. This method is connected with the paired t-test method in order to support and verify the result and the significance of each participants' answer on the post-survey questionnaire. With these methods, the researchers would be able to determine the effect of the ergonomic console chair on the performance and experience of the participants.

4. Results and Discussion

4.1. Results

Table 4.1 shows the scores the participants garnered during their first and second session using the non-ergonomic chair. It also shows the average of both sessions and how much the scores from the second and session increased or decreased from the first session.

Table 4.1 Results of Non -Ergonomic Chair

Participant	1st half result	2nd half result	Average	Decrease/Increase
A	7775	8545	8160	770
B	2975	4950	3962.5	1975
C	14300	18695	16497.5	4395
D	15695	16890	16292.5	1195
E	14450	20940	17695	6490
F	5375	9920	7647.5	4545
G	5350	9125	7237.5	3775
H	9965	8465	9215	-1500
I	10575	12175	11375	1600
J	11890	12635	12262.5	745

Table 4.2 shows the scores the participants garnered during their first and second session using the ergonomic chair. It also shows the average of both sessions and how much the scores from the second session increased or decreased from first session. In addition, it also presents how much the mean score attained from using the ergonomic chair improved from the scores attained while using the non-ergonomic chair.

Table 4.2 Results of Ergonomic Console Chair

Participant	1st-half result	2nd-half result	Average	Decrease /Increase	Improvement from Ergo chair
A	14675	16230	15452.5	1555	7292.5
B	5955	9950	7952.5	3995	3990
C	21630	19755	20692.5	-1875	4195
D	21715	22925	22320	1210	3090.5
E	18755	20980	19867.5	2225	2172.5
F	13280	13340	13310	60	5662.5
G	9425	11560	10492.5	2135	3255
H	10200	11450	10825	1250	1610
I	13275	14500	13887.5	1225	2512.5
J	14370	14845	14607.5	475	2345

Table 4.3. Comparison of Non-Ergonomic Chair and Proposed Ergonomic Console Chair

Pains/Discomfort Experienced Using the Non-Ergonomic Chair	Non-Ergonomic Chair Features	Ergonomic Console Chair Features
Back pains	The back support did not have any curvature that supports the spine.	<ul style="list-style-type: none"> • The back support designed to follow the natural curvature of the spine of humans. • The normal anthropometric measurement was incorporated. • The back support can be reclined. • Presence of the designed underarm support to prevent slouching
Numbness of the arms/Shoulder pain	Absence of arm support	<ul style="list-style-type: none"> • Presence of the designed underarm to supports the shoulder blades in the healthy position. • The underarm support has an adjustable height with an interval of 3 inches.
Numbness of the buttocks	Inadequate cushion	Add more cushion to increase comfortability and prevent numbness of the buttocks.

The researchers tested the ergonomic console chair's effect on the user's comfort and experience while observing the participants while playing.

Table 4.4. Observations During the Experiment

Participant	Observations
A	Non-Ergonomic Chair: Upright to severely slouched on the non-ergonomic chair. Ergonomic Chair: none
B	Non-Ergonomic Chair: Not used to the underarm rest which resulted to discomfort in the forearm on the ergonomic chair. Ergonomic Chair: none
C	Non-Ergonomic Chair: none Ergonomic Chair: Had slight discomfort in the arms while using the underarm support due to the dimensions of the ergonomic chair.
D	Non-Ergonomic Chair: Only has one position and has a slouched back on the non-ergonomic chair. Ergonomic Chair: Relaxed, less pressure felt because of the comfort of the ergonomic chair
E	Non-Ergonomic Chair: Buttocks hurt on the non-ergonomic chair. Ergonomic Chair: Felt the arm support was too high on the ergonomic chair.
F	Non-Ergonomic Chair: none Ergonomic Chair: The ergonomic chair fixed his posture unlike in the non-ergonomic chair and it was very comfortable to the back.
G	Non-Ergonomic Chair: Buttocks hurt on the non-ergonomic chair Ergonomic Chair: Comfortable but too low for his liking on the ergonomic chair.
H	Non-Ergonomic Chair: Changes positions every 2-3 minutes on the non-ergonomic chair. Ergonomic Chair: none
I	Non-Ergonomic Chair: Slouched during the non-ergonomic chair. Ergonomic Chair: He was taking his arms off of the underarm support at times on the ergonomic chair.
J	Non-Ergonomic Chair: Buttocks, lower back, and wrist pain in the non-ergonomic chair. Ergonomic Chair: Had discomfort in the right arm but left arm is fine because he is used to having his left arm raised, lower back did not hurt anymore on the ergonomic chair.

The participants also gave the following recommendations to improve on the chair:

- More freedom to adjust armpit support.
- Make the ergonomic chair more adjustable for different body types.
- Make the armrests adjustable to different heights.
- More cushion on the buttocks area.

During the experimentation period, it was noticed there was one factor affecting the participants' scores; despite trying to maintain the setup of the experiment as controlled as possible, the participants' performance appeared to be affected

by how their day went. Some participants had a stressful day while others did not, and this resulted in an inconsistent performance based on their score. In order to solve the discrepancies, it was decided to only consider data gathered during experiments conducted in the morning or time prior to school. Finally, the researchers conducted the same experiment with different participants to replace those that were removed.

Statistical Analysis

4.2.1 Hypothesis Testing

First Session

H₀: The results of the first session between the ergonomic chair and the non-ergonomic chair are not significantly different.

H₁: The results of the first session between the ergonomic chair and the non-ergonomic chair are significantly different.

Level of Significance: 0.05

p-value: 0.04

Type of test: Two-tail test

Result: Reject H₀

The resulting p-value is 0.04, which is less than the level of significance which is 0.05, thus leading to the rejection of the null hypothesis. In this case, all of the scores of the participants increased when they sat on the ergonomic chair. According to Smith (2018), a gaming chair is tailor-made to help the body function naturally as a person plays and in turn, the gamer would be able to improve its performance. The result of the simple t-test analysis reveals that the use of the ergonomic console chair can improve one's gaming performance.

Second Session

H₀: The results of the second session between the ergonomic chair and the non-ergonomic chair are not significantly different.

H₁: The results of the second session between the ergonomic chair and the non-ergonomic chair are significantly different.

Level of Significance: 0.05

p-value: 0.1

Type of test: Two-tail test

Result: Accept H₀

The p-value is 0.06, which is greater than the level of significance which is 0.05, thus suggesting accepting the null hypothesis. According to a study conducted by Ritter and Schooler (2001), the traditional view of skill acquisition is the assumption that innate biological capacities limit the level of achievement that a person can attain. This suggests that while improvement exists, it varies by the time it reaches a certain time. Much like an asymptote, the improvement is inherently more significant and noticeable during the beginning when compared to their improvement in the latter parts of their experience. Because of this, the second session of the experiment resulted the scores to be significantly different.

Paired t-test

Questions 1, 2, and 6 of the post-survey are analyzed together since their tallies are the same; all ten of them are positive. The researchers' null hypothesis is that the results of the second session between the ergonomic chair and the non-ergonomic chair are not significantly different, or that the difference between the two equals 0. The results of the paired t-test suggest that the null hypothesis should be rejected.

The tally on question 3 has shown that six of them are positive, one of them is negative, and three of them are neutral. The researchers' null hypothesis is that the results of the second session between the ergonomic chair and

the non-ergonomic chair are not significantly different. The results of the paired t-test also suggested the rejection of the null hypothesis.

The tally on question 4 has shown that nine of them are positive and one of them is neutral. The researchers' null hypothesis is that the results of the second session between the ergonomic chair and the non-ergonomic chair are not significantly different. The results of the paired t-test also suggested that the null hypothesis should be rejected.

The tally on question 5 has shown that seven of them are positive, two of them are negative and one of them is neutral. The researchers' null hypothesis is that the results of the second session between the ergonomic chair and the non-ergonomic chair are not significantly different. The results of the paired t-test suggest that the null hypothesis should be rejected.

The tally on question 7 has shown that eight of them are positive, and two of them are neutral. The researchers' null hypothesis is that the results of the second session between the ergonomic chair and the non-ergonomic chair are not significantly different. The results of the paired t-test suggest that the null hypothesis should be rejected.

4.2.2 Regression

The results showed that the strength between the non-ergonomic scores and ergonomic scores is indicatively high (0.9182), and that the correlation coefficient is very highly significantly different from zero ($P < 0.0002$). Also, the researchers can say that 84% (0.9182^2) of the variation in the scores in the ergonomic chair is explained by scores in the non-ergonomic chair.

4.2.3 Summary of Findings

The researchers intend to determine whether the ergonomically designed console chair has a positive effect on the user's comfort and performance while gaming. In order to accomplish this, various statistical methods for the analysis of the data gathered from the experiment were conducted. The results were classified into two parts: the qualitative and quantitative data. The quantitative data consists of scores acquired in-game during the experiment. This variable is used in measuring the improvement of the participants in using the non-ergonomic and ergonomic chairs. On the other hand, the qualitative data consists of information gathered from the observations during the experiment. However, during the experimentation period, the researchers noticed a factor affecting their performance: the participants' moods. In order to solve the discrepancies, it was decided to only consider data that were gathered during experiments conducted in the morning or time prior to school. The researchers conducted the same experiment with different participants to replace those that were removed from the data.

5. Conclusion

The objectives of the research have been met, it was able to design an ergonomic console chair with a special underarm support feature to improve posture of users, performance, and user's experience. The ergonomic console chair's design was based on the related literature and the anthropometric data of Filipino males of ages 16-20. Based on the statistical analysis, the ergonomic console chair has proven to be effective in increasing the user's experience and performance.

6. Recommendations

The researchers would like to recommend conducting another study with a bigger sample size. More respondents would lead to more varied feedback in terms of comfort. The effects in terms of performance could also be affected with this change. The experimentation methods could also be improved upon for future researches. A simpler, emptier playing setup and environment wherein there are fewer variables could be considered for the experiment. The researchers would also recommend testing the chair for longer gaming periods using various genres of games. One key recommendation the researchers would like to give is to use a different experimentation process which would make use of a non-gaming ergonomic chair instead of a normal stool and to compare it to the console gaming chair, once again in terms of experience and performance. Being compared to an ergonomically designed chair would further strengthen the chair's case for its effects on the user.

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Biography

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