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ERGONOMICS DESIGN ANALYSIS TOWARDS GAMERS' PREFERENCES IN COASTAL ESPORTS ARENA

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Abstract

Esports activities are developing very rapidly, encouraging the people's desire to build its distinctive building, an esports arena to support its activity. However, there is no specific spatial form for planning the main room's interior of esports arena, especially in coastal areas. The absence of guidelines to be applied can lead to less ergonomic spatial planning. This research applies the mixed descriptive method by collecting primary data of questionnaire and secondary data of existing buildings from any official information source as the object of research analysis. With digital information source, source triangulation method is used to identify an ergonomic layout and furniture form to be used by the player and audience within the esports arena building in the coastal zone. The result of this study provides the statistical data of Batam citizens' perception about most ergonomic design and an overview of ergonomic layout based on total respondents that can be applied to planning the coastal esports arena building.

***Keywords**: coastal esports arena; ergonomic architecture; spatial adaptation*

INTRODUCTION

Esports or electronic sport(s) is one of activities that has been evolving worldwide, including in Indonesia. In the beginning of its existence, Esports was not entirely an extensive activity and only consisted of activity like playing an electronic or video game, especially games that could be played cooperatively or commonly called "multiplayer". Nowadays, it has evolved so significantly that such competitive matches of video game are held, starting from local, smaller scale to the international or worldwide level.

Esports arena building or its equivalent surname, esports stadium is used to support its activities from the video games that are popular and being played worldwide. Following the era, theme of architecture applied to it dominantly is futuristic or contemporary style. The reason the theme was selected is so that it can bring a competitive condition and "*(we) are in a science fiction world*" type of vibe for the visitors (Julius et al., 2016), also to attract attention from societies of the whole world, especially the event organizer that is searching for a location for holding an esports tournament.

There are only a few place, venue or building in Indonesia that is used to support esports shows, even unavailable in some provinces. In Batam's case, most were held in vast place inside a building, like a mall atrium and the school hall.

Figure 1. A local esports tournament being held inside the mall hall in Batam City Square, Batam, Riau Islands

Another case from Surabaya stated that uncountable numbers of esports events were primarily held inside the mall, and the building details needed to be more ergonomically supported (Ramadhan et al., 2020). This same phenomenon occurred too in Jakarta due to no functional esports building in its city (Yani, 2022). With no distinctive building to facilitate the esports shows, it is clear that Batam is not a strategic place for holding large-scale esports competitions. The unavailability of a building with this function impacts the esports entertainment industry sector, which

causes most of esports tournaments to be held virtually or with hybrid system (combination of face-to-face and online with a predetermined schedule) (Lim & Setiawan, 2022).

Designing a building for esports arena is not much different from designing a joint sports stadium or a theater because of some similarities. One of the similarity is the audience seat arrangement or formation. However, the esports arena is designed futuristically with the current media technology, e.g. a large LED panel placed at the back side of the stage to support the audience to spectate ongoing virtual match played by both esports teams. With that design, there can be a question regarding the ergonomic side of the user, especially about volumetric and physiology aspects (Santoso et al., 2018; Migliore et al., 2021).

Some Indonesian esports athletes have won several multilateral esports tournaments that have won the top 10, even the top 3 champions. Nevertheless, this effort still needs to motivate any parties' attention to start building a venue or arena specifically for esports shows in Indonesia when or if it is selected to become the host for an esports tournament. Therefore, coupled with the rapid development of the esports entertainment industry (Migliore, 2021; Reitman et al., 2020) and the lack of information regarding the architectural design guidelines (building, room, etc.) for esports activity, an idea is obtained for the authors to begin researching ergonomic architecture suitable for esports arena building type. This study aims to identify and provide an overview of the ergonomic layout and its furniture shape based on Batam citizens' preferences that can be applied to planning an esports arena in the coastal zone.

LITERATURE STUDY

Esports and Its Building

Esports, or an abbreviation of electronic sports is an activity that uses and relies on video game and gaming electronics as the tools (Jung, 2022). At first, it was supposed to be a hobby for the users to get rid of their boredom after doing their daily activity (Aprillina et al., 2019). In the sports environment, it is still being a polemic regarding it including "esports" as a sport (Kane & Spradley, 2017). However, It still gain huge attention from society and has many potential in business matters, especially creating a job as a professional esports athlete and boosting a marketability for gaming electronic products (Parshakov et al., 2020; Reitman et al., 2020).

To holding an esports shows like tournament, video game exhibition, etc. needs a sole building, esports arena to support its main activity. Esports arena (or esports stadium) is a building that is used to facilitate the esports activities for accommodating the esports and gaming community. The building for activity mentioned before should be multifunctional building (Frendi, 2018) to create and maintain the esports and business ecosystem working in there (Reitman et al., 2020). For the case in Indonesian architecture of esports studies, many esports arenas' building exteriors are designed with futuristic or any theme which its shape is recognizable to esports enthusiasts and attracts the visitor and stakeholders. (Ramadhan et al., 2020; Ardiyanto et al., 2021; Negoro et al., 2022). Regarding to interiors, there are rooms required specifically for an esports activity: lobby, tournament area or arena, IT exhibition, café, LAN gaming area, and commentator-and-analyst rooms (Julius et al., 2016). At the minimum, an esports arena must have a stage as the main room of the building to facilitate competitive esports matches. Hence, its name is called "arena".

Ergonomics within Architecture and Esports

Broadly, ergonomics is the multidisciplinary approach to optimize human-activity system, so that the healthy, safe and efficient tools or environment can be achieved (Hutabarat, 2017). Then, narrowly, it is a fundamental of understanding how human as the user behaves with the context of sociotechnical systems (Wilson, 2000). According to Occupational Safety and Health Administration (2018), it is the science of fitting the jobs to workers (users) instead of otherwise. Concluding these meanings, it is clear that ergonomics is a branch of knowledge that studies correlation of human behavior with their activities based on the context they want to fulfill.

Ergonomics and architecture study are correlated each other regarding the interior designing matters (Santoso et al., 2018). In ergonomic studies, Wardani (2003) states that there are four scopes of ergonomics research:

a. Research on display;
b. Research on human physical strength;
c. Research on workplace dimension; and,
d. Research on work environment.

Seeing the scopes of its research, Wardani explains that to design an interior layout, designer needs to analyze first about anthropometry, (a study of analyzing human body dimension) human physiology and psychology.

Researches of ergonomic studies in esports environment had been done several times, mostly on industrial and/or product design and medic or cognitive science fields (Migliore et al., 2021). McGee (2021) describes that there are several body parts that are affected by gaming activities, including neck, head, trunk, arms, and lower limbs towards gaming devices, such as PC, console and mobile. Moreover, spine is the body part that is also affected by that activity (Lam et al., 2022). To cope with those issues, ergonomists and/or product designers are involved to minimalize the impact of physiological diseases occurred by gaming habits (Lipovaya et al., 2019).

Designing an ergonomic product for esports and video gaming activities require to know their physiological and ergonomics considerations first, one of them is the infrequently body movement while playing a video game (McGee & Ho, 2021).

Nowadays, many furniture for video gaming like an ergonomic set of chair and table have been proposed to solve the mentioned problem (Aprillina et al., 2019; Santoso et al., 2018).

Coastal Region, Population and City

Coastal is a region that meets, also separates the land and the sea zones (Murtiono et al., 2023). In general, coastal is the geographical area that, either the terrestrial (land) or the submerged in water, is outlined for coastal zoning purpose (Finkl, 2016 in Hossain et al., 2020). Dahuri (2004, in Khakhim et al., 2008) describes the characteristic of coastal region where:

1) Landward boundary includes the land part, either dry or submerged area, that is still affected by the sea's feature: sea breeze, sea tides, and sea water intrusion; and
2) Seaward boundary includes sea water far away from continent's seashore that is either still natural or affected by manmade activities: deforested sea forest (mangroves) and/or any pollutions.

Indonesian minister of settlements and regional infrastructure in (2003) stated that within 50 kilometers from Indonesian shorelines, lived 60% of Indonesia's population with at least 132 million people by that time. The reason places in coastal zone are sustaining and well planned is its community-based development that improves the area where they have been living (Dewi, 2018). They combine their community needs to usage of the potentials that can be gained from the sea, such as its resources and natural features for their living. The coast is also a strategic region to develop a living, sustainable place due to its easily-developing topography or terrain and excellent access for infrastructures (Yonvitner et al., 2016).

Indonesia is a maritime, archipelagic country and a home of 18,110 islands within its region (Suharsono, 2010). With this geographical characteristic, Indonesia has many potentials that can be utilized for beneficial purpose, but its coastal zones are relatively unexploited by the local government (Lasabuda, 2013). The potentials they could exploit and manage according to Yonvitner et al. (2016), if handled well, are developing the sustainable food source and ecotourism, especially developing some seashore buildings for improving marine tourism in one place.

Batam is the largest city, also the largest isle in Riau Islands. Batam be mentioned as the largest city is because of it being an isle connected with 4 regions: Singapore, Malaysia's Johor, Indonesia's Riau and Thailand (Fatima, 2022; Roziqin & Kusumawati, 2017). With those connections, Batam has many potentials that are very profitable for Indonesia and its province. Fatima (2022) explained that Batam's tourist objects (destinations) rely on coastal areas. Hence, to boost the tourism in Batam, the shore lands and coastal uplands are widely used to develop harbors and tourist-attracting destinations. In Batam's case besides Barelang Bridge being an icon for the city, a coastal village can be functioned opportunistically into a culinary destination, e.g. Kampung Tua Tiangwangkang (Murtiono et al., 2022).

RESEARCH METHODOLOGY

Research Design (Scope and Instruments)

This study research design uses mixed-method simple research concept with deductive literature development, archival research as research strategy, mixed-method simple methodological choices with descriptive explanation, and implementation time for research doing in a cross-sectional method (one point in time). The scope of this study concentrates toward building interior with addition of the ergonomic principles to be applied on furniture (its form), also main room of esports arena, specifically designed on coastal zone. To avoid explaining unneeded information, the study limits its scope by focusing on ergonomics research of human physical strength and workplace dimension. To obtain the data as the source for analyzing, this study utilizes questionnaire and documentary to find some statistical information related to the research scope.

Data Collection Technique

Every research has its own methodology, especially the technique of collecting data. This study relies on primary and secondary data. Primary data means that the information can be obtained from the direct information source and becomes new information for this research, while the secondary data means to get the information that has been stated by other researchers, reporters or any important figures. To collect data in this research, questionnaire and documentary methods are used.

Questionnaire is a primary data collection method in the form of several questions written and given to respondents to be answered (Sugiyono, 2013). Its questions will be prepared and distributed virtually to Batam citizens as the respondent, asking them about their perception about esports and which forms and positions are more ergonomic for gaming. Documentary study is a method to collect previous studies, other references or any scientific works written on paper or paperless (digital) and rely on them without doing the on-field observation (Zed, 2008).

Data Analysis and Validation Technique

The first steps of analyzing data is to collect the data first. After collecting them, the data must be analyzed and validated first before yielding the conclusions. Each data collected must be filtered or analyzed in order to provide clear and factual information as result of every research conductions. To analyze the data in this study, Miles & Huberman's (1994) "qualitative data analysis" is used due to their distinguished three steps of analyzing qualitative data: data reduction, data display and conclusion drawing.

By using this data analysis method, the results and discussion will be clearly interpreted and displayed as what the scope of this research is decided.

Validation data is needed in every study to be considered scientific and serious research. The technique used for validating data is the triangulation method. Triangulation is one of the research method that combines two or more data collection techniques not only to find the desired answer, but also to understanding more about the subject or context of the study is being conducted (Hardani et al., 2020) In this study, the source triangulation is used to summarize the responses from questionnaire, determine which concepts is more ergonomic based on highest votes and apply them to the new design guidelines for esports arena as the novelty, also the conclusion of the research.

RESULTS AND DISCUSSION

Existing Information about Esports Arena and Others Wide Span Space

The event of esports such as a competition or tournament usually takes place in venues such as wide space like exhibition center, but due to huge development of esports industry sector, there are esports arena projects in construction and several building were complete or gone gold, e.g. Arlington Esports Stadium. In fact, Mirakian (2019), the project director of AES stated that it isn't purely a sole building exclusively designed for esports events, but a renovation of its old building, previously named Arlington Convention Center.

Figure 2. Interior view of Arlington Esports Stadium main stage (Mirakian, 2019)

AES has a total space of 9,300 m^2 rounded and its stage hall can provide up to 2,509 seats (*arlington.org*, n.d.). Interior-ly analyzing in the main room (stage), AES uses panels of LED with the width of 90 feet (27.43 meters) as display screen, placed backstage and above the professional esports athlete setups with unknown height dimension, obviously higher than 1 human-body height as shown in Figure 2. The audience zone as shown in the figure, it can be said that it was designed flat (elevation) and uses folding chairs as the seat in order to be more flexible in arranging seats layout and maximize capacity needs based on the scale of an event.

Arlington Esports Stadium is the only esports arena that shares many information about project and details of its kind. Despite the rapid development of esports entertainment sector, the detailed drawings of finished-construction esports arenas spread or archived in the internet are scarce, including AES which the dimensional details of each rooms are not shown, but just vector-style images of it and only depicted as the zones. There are several architectural projects that involved into designing an esports arena, but are very limited and most of them are only conceptual designs.

Audience seat is one of the most important element in designing rooms that need to accommodate many people, like in cinema, arts performing center, amphitheater, etc. In example, the audience seat of concert hall and Joan Sutherland theater venue in Sydney Opera House are gradual or multi-storey unlike Arlington Esports Stadium as shown in figure below. Volumetrically speaking, Seck (2019, in Yani, 2022) from his esports building analysis shown that the capacity of audience in stadium or arena has at least 400 seats, observed from 12 buildings of its kind. Therefore, the audience seat details from Sydney Opera House should be good references for designing the seats layout of esports arena.

Figure 3. Concert Hall (left) and Joan Sutherland Theater (right) inside respective buildings in Sydney Opera House (Yani, 2022)

Ergonomics Scope Analysis

The concentration of this study is limited only to focus on stage as the main room for holding esports activities. Such design, especially interiors, must meet the user's comfort criteria to be acknowledged as well-designed: healthy, comfort, safe, and better functional efficiency (Pheasant, 2003). With the references from existing ergonomic interior products, the form concepts for gaming setups and esports arena main stage can be illustrated.

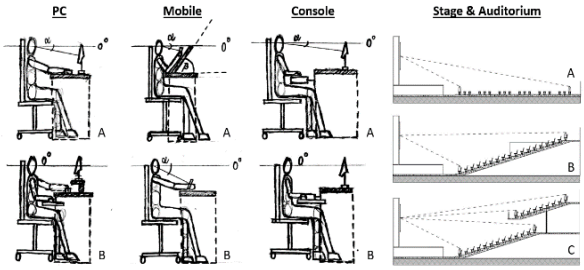

Figure 4. Seating or Auditorium layout and furniture-user design concepts for esports arena

To fulfill criteria above, user-centered approach is recommended by Pheasant because the method is pragmatic and considers the user's (esports athlete or player) task. The method is applied into questionnaire to gather data from respondents, answering about which layout or form and the user's position is the best (more ergonomic; provides greater comfort and is healthier) for doing some physical activities in esports events. Based on answers from random respondents in Batam, some form concepts are chosen as ergonomically better to be applied into designing an esports arena as shown in Table 1.

Tabel 1. Voting results from Batam citizens as questionnaire respondent on ergonomic design guideline for esports arena

Categories	Choices	Results (N = 33)	
Form Concept of User-Furniture; PC	A	13	39.4%
	B	20	60.6%
Form Concept of User-Furniture; Mobile	A	7	21.2%
	B	26	78.8%
Form Concept of User-Furniture; Console	A	8	24.2%
	B	25	75.8%
Layout Concept of Main Stage and Auditorium	A	3	9.1%
	B	17	51.5%
	C	13	39.4%

Esports Arena Hall Concept Design

The types of esports competition varies based on the devices used for compete. Therefore, the gaming desks should be designed, adapting what type of device will be used for playing the game to give maximum comfort to e-athletes.

The form concepts of user-furniture were determined with statistical data showing which is considered more ergonomic or user-friendly for each concept. Next thing to do is to analyze about the workplace of auditorium descriptively. In this study, two aspects will objectively be described here:

a. Volumetric design: Such room must accommodate certain numbers of people depends on its function. Neufert & Neufert (2000) explains that to design an auditorium for a wide-span room, the space of 0.5 m2 per spectator or (≥90 x ≥50) cm for each seat is recommended. Within the length space (≥90 cm), De Chiara et al. (1992) added that it must be provided a clear space of at least 12 inches (30.5 cm) for circulation. The seat arrangement (aisle or continental, aligned or staggered) is designed depending on space availability or planned capacity. Rows of seats should be separated with at least 20 cm height per row.
b. Physiologic design: Sitting habit affects spine and pelvis mechanic (Pheasant, 2003) and less ergonomic furniture can cause discomfort to the bones of users. To resolve this issue, details on the seat must be modified. Pheasant suggested the design of seat and its backrest to be tilted, recommended at 5-10° angle. The visibility and head movement are also a consideration on designing seat because of the relevance of it with cervical spine. For a compromised measurement, averagely 111.76 cm eye height when in sitting position is recommended with preferred display zone (towards stage or screen) angle up to 30° vertically based on the seat row elevation (De Chiara et al., 1992; Pheasant, 2003). Neufert & Neufert (2000) added that the stage width measurement, too, should be taken into consideration so that a viewer can wholly (left-to-right corner) spectate the activity on stage with horizontal angle of 30° (less or no head movement) up to 110° (maximum comfortable view condition, but requires more head movement).

With the gathered data from questionnaire responses and existing architecture references, a main stage with auditorium is modelled in only small area for conceptual explanation.

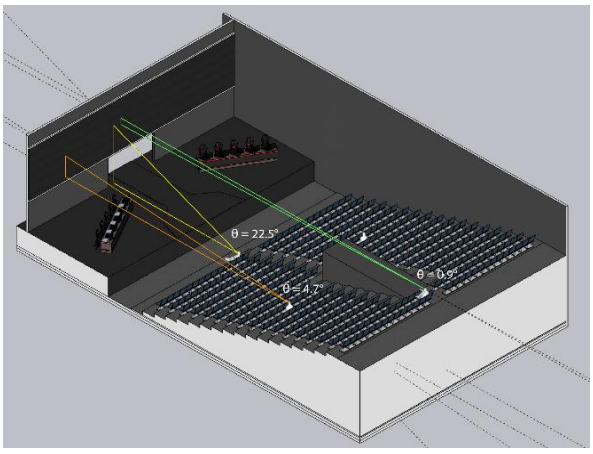

Figure 5. Conceptual isometric view of ergonomic esports arena hall, measuring the ergonomic vertical viewing angle from spectators' eye to display screen

This study excludes the dimensional details, such as width-depth-height of the room (hall) and the length-width of the stage. The seating capacity is also

excluded as there are various agreements or needs from every construction projects. In this study, the entrance to hall may be located wherever, either from side of the room or at certain spot(s) in the middle of auditorium as shown in Figure 9. The only two things described in it are the details of horizontal and vertical viewing angle to be considered as ergonomic for spectators in esports arena hall.

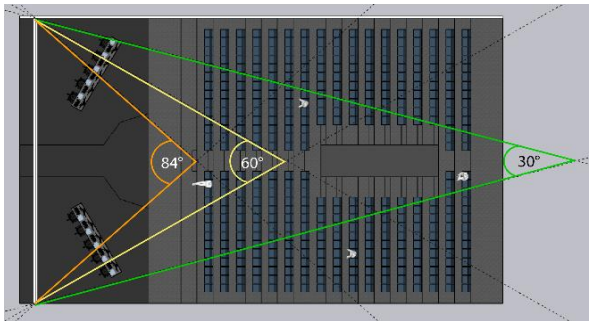

Figure 6. Horizontal viewing angle of esports arena auditorium, measured from spectators' eye facing left-right corner of the stage

CONCLUSION

The esports entertainment industry has been growing rapidly and the interest from people into it is still increasing, but a sole building to support its activity is still lacking, especially the design guidelines and the ergonomic aspect for esports activity. Batam citizens, based on the questionnaire results, expressing that there were only few esports events held in their city and mostly are mobile-type video game local tournaments. Therefore, this study provides the simplified information of ergonomic design guidelines for measuring indoors of esports arena on coastal zone for future construction. Coastal zone is mentioned due to its massive human population within it to attract them visiting the arena, so volumetric design must be considered.

Do note that in this study only focuses on esports arena main stage or hall ergonomically and volumetrically, there are suggestions for the next study. Researchers of this study recommend for the next study to focus deeply on the volumetric design for coastal esports arena and improving the theory of ergonomics for electronic sports by continuing the dimensional details from this study's user-furniture form concepts.

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