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Development of badminton field and net height for class 5 and 6 students of sdn sukodadi 02 paiton district, probolinggo regency

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Abstract
Education is one of the efforts that students need to obtain, in order to develop the abilities and potential that exist within them. In effective physical education, it is necessary to pay attention to the facilities and infrastructure used. The facilities and infrastructure used must be appropriate to the body structure and needs of students. This needs to be considered so that learning objectives can be achieved. The aim of this research is to develop a product in the form of a badminton court and net that suits the anthropometric structure of students, namely the stride length and body height of grade 5 and 6 students at SDN Sukodadi 02, Paiton District, Probolinggo Regency. So you can play badminton comfortably because the facilities and infrastructure used are in accordance with students' needs. This research method uses the development method, then for the research model it refers to the Borg and Garl development research model. However, researchers modified the model so that it suited research capabilities and needs. The steps taken are (1) Needs analysis and field observation, (2) Initial product creation, (3) Expert evaluation, (4) Small group trial using 12 subjects, (5) Product revision, (6) Trial large group using 40 subjects, (7) Revise the final product and create the final product. Based on the results of expert tests, small group trials and large group trials, it was concluded that badminton field and net height development products for grade 5 and 6 students at SDN Sukodadi 02 Paiton District, Probolinggo Regency could be used interestingly and usefully. As an effort to disseminate products that have been developed to a wider target, the products that have been developed should be re-evaluated and then adjusted to the existing situation and conditions.

Keywords: Development, badminton court, badminton net

Introduction
Regular exercise can make the body healthy. There are various kinds of sports to date (Kusuma *et al*., 2023) [9]. Starting from aerobic exercise to non-aerobic exercise, (Luo *et al*., 2022) [11]. Aerobic exercise is exercise that uses oxygen in the process of providing energy. Non-aerobic exercise is exercise that does not use oxygen to provide energy. This type of exercise has very fast movements (He *et al*., 2024) [7]. An example of this sport is badminton.
Badminton is a racket sport played by two people (for singles) and four people (for doubles) who play against each other (Kusuma *et al*., 2020) [10]. When playing badminton you need a badminton court, racket, shoes and shuttlecock (Tung *et al*., 2022) [15]. Badminton courts in Indonesia use standard courts, namely the size of the court is 13.40 m long and 6.10 m wide and the net height is 1.55 m. There are currently two fields available, namely an indoor field and an outdoor field.
This standard badminton court is intended for adults, starting from the size of the court to the height of the badminton net. So when creating this standard field it refers to the anthropometric structure of the adult body (Deng *et al*., 2024) [3]. In Indonesia, students in grades 5 and 6 of elementary school have an average height of 179.40 cm and a stride length of 53.19 cm. Meanwhile, the average height reached by adults is 221.75 cm, and stride length is 79.90 cm (Barnamehei *et al*., 2021) [1].
Looking at the differences in anthropometric structures above, of course standard courts

cannot be used by students in grades 5 and 6 of elementary school, because standard badminton courts do not suit the stride length and height achieved by elementary school (SD) students (Nolasco *et al*., 2022) [13]. So it is necessary to have a badminton court that suits the anthropometric structure of grade 5 and 6 elementary school students. In fact, the muscle strength of 5th and 6th grade elementary school students is classified as young muscle where strength is still low (Utomo *et al*., 2024) [16]. This has the impact that when doing a lob, the arm muscles are not able to hit hard so the shuttlecock often does not reach the back area of the opponent's court (Utomo *et al*., 2024) [16].

The function of the lower limb muscles is also still not perfect. Even though they have taken maximum steps (Dwi Jayanti *et al*., 2022) [4], the steps of elementary school students are not the same as those of adults (Fong *et al*., 2023) [5]. So when children step to reach the shuttlecock which falls far from the body, they find it difficult because of the size of the badminton court. Besides that, students find it difficult to serve if they use a standard net. Shuttlecocks often get stuck in the net, this is caused by the net being too high. The same thing is obtained when students do a smash, the shuttlecock often cannot cross to the opponent's court. Therefore, it is necessary to have a field and net height that is appropriate to the anthropometric structure of grade 5 and 6 elementary school students.

The above is also supported by the science of biomechanics, matters regarding anthropometric structures are also related to movement in a sport (Maksum & Indahwati, 2023) [12]. In badminton, when a child serves or lobs, whether the shuttlecock enters or not is also influenced by the length of the child's arm. This uses biomechanical analysis, specifically the moment of force. To calculate the moment of force (T) = force (F) x force arm ( ), (Panda *et al*., 2022) [14]. So if the force arm ( ) becomes longer, the resulting force moment will also increase (Kaldau *et al*., 2021) [8]. Therefore, people who have longer arms will find it easier to serve or lob (Grice, 2008) [6]. Based on this, it was found that students in grades 5 and 6 of elementary school had more difficulty performing a serve or lob movement compared to adults because their arms were shorter (Brahms, 2010) [2]. Apart from the above, the reason why it is necessary to develop badminton courts and net heights is because there are no courts and net heights that suit the anthropometric structure of grade 5 and 6 elementary school students.

Another reason why it is necessary to develop badminton fields and net height is needs analysis through observation. The results show that students have difficulty in making basic strokes in playing badminton. When serving and smashing, the shuttlecock often gets caught in the net. This is caused by the net being too high. When performing a lob, most of the shuttlecock produced does not reach the back of the opponent's court.

To support the observation results, a needs analysis was also carried out through tests, it was found that the child's ability to perform basic strokes was still low. By using a standard court, as many as 25.93% of students successfully served, 26.86% of students lob, 40.95% of students smashed and 45% of students mastered the field. From some of the data obtained, the author tried to develop the field and height of the badminton net for grade 5 and 6 elementary school students in accordance with the anthropometric structure of grade 5 and 6 elementary school (SD) students.

Method

This research development model uses a procedural development model, this research refers to the development model from Borg and Gall (1983:775). The researcher only used 7 steps from the Borg and Gall development model, the researcher translated directly from these steps. This was taken with careful consideration. If you use the 10 steps from the Borg and Gall development model, then the existing field conditions do not allow this to be fulfilled. The subjects tested in the operational field test were 10-30 schools with 200 subjects studied. The research procedures carried out are as follows.

Needs Analysis

Before carrying out development, the researchers first conducted a needs analysis regarding the field and height of the badminton net for grade 5 and 6 students at SDN Sukodadi 02, Paiton District, Probolinggo Regency. Needs analysis is carried out through observations by researchers. Apart from that, a needs analysis was also carried out through a badminton skills test using standard courts at the school.

These skills tests include lob tests, serve tests, smash tests and field mastery tests by observing students' steps. The results of the needs analysis were consulted with badminton experts and physical education learning experts. The purpose of the results of this need is to find out the needs that the subject wants which will result in a product, namely a badminton court and net height for grade 5 and 6 students at SDN Sukodadi 02, Paiton District, Probolinggo Regency.

Anthropometric measurements

Anthropometric measurements were carried out on students in grades 5 and 6 of SDN Sukodadi 02, Paiton District and Health and Physical Education students at the State University of Malang. These anthropometric measurements include measurements of body height, reach height and stride length. The purpose of this anthropometric measurement is to determine data on body height, reach height and stride length of pupils and students. These anthropometric measurements are used as a basis for determining the size of the court and the height of the badminton net according to the stride length and height achieved by students in grades 5 and 6 at SDN Sukodadi 02, Paiton District. In carrying out measurements, the tools used have been retested by the metrology agency, the certificate can be seen in the attachment.

Making Initial Products for Badminton Courts and Badminton Nets

Based on the needs analysis and anthropometric measurement data above, an initial product for the field and badminton net height was created for students in grades 5 and 6 at SDN Sukodadi 02, Paiton District, Probolinggo Regency. The way to make an initial product is by analogizing and carrying out a comparison process. By analogy, with the average height of adults and the height of the badminton net used for adults is 1.55 meters compared to the height of elementary school students, the net height required for students in grades 5 and 6 at SDN Sukodadi 02, Paiton District Probolinggo Regency can be determined. Meanwhile, with the maximum average stride length for adults and the length and width of a badminton court, namely 13.40 meters and 6.10 meters compared to the average stride length of elementary school students, the size of the court required for grade 5 and 6 students at SDN Sukodadi 02 Paiton District, Probolinggo Regency can be determined.

Development products were tested on badminton and physical education learning experts. The product of this development is a badminton court and net height that is adjusted to the anthropometric structure, namely the stride length and height achieved by grade 5 and 6 students at SDN Sukodadi 02, Paiton District, Probolinggo Regency. Next, a small group trial was carried out and a large group trial was carried out.

The instruments used are observation measurements, anthropometry, tests and documentation. This data collection instrument has been justified by physical education learning experts and badminton experts. The data analysis technique in this research uses quantitative descriptive analysis techniques with percentages, for field products and badminton net height it is carried out using analogy data analysis techniques and comparison processes.

By analogy, with the average height of adults and the height of the badminton net used for adults is 1.55 meters compared to the height of elementary school students, the net height required for students in grades 5 and 6 at SDN Sukodadi 02, Paiton District Probolinggo Regency can be determined. Meanwhile, with the average maximum stride length for adults and the length and width of a badminton court, namely 13.40 meters and 6.10 meters compared to the average stride length for elementary school students, the size of the court required for grade 5 and 6 students at SDN Sukodadi 02 Paiton District, Probolinggo Regency can be determined.

Results and Discussion

Products

Before presenting the third product or final product of this research, the first product, second product and final product will be presented.

Product I (Initial Product)

This product was obtained from an analogy through the process of comparing several aspects of elementary school students, standard badminton courts, and using a comparison of Physical Education and Health students at the State University of Malang. Apart from that, this initial product was also created based on input and suggestions from badminton experts and physical education learning experts. An image of the initial product can be seen in Figure 1.

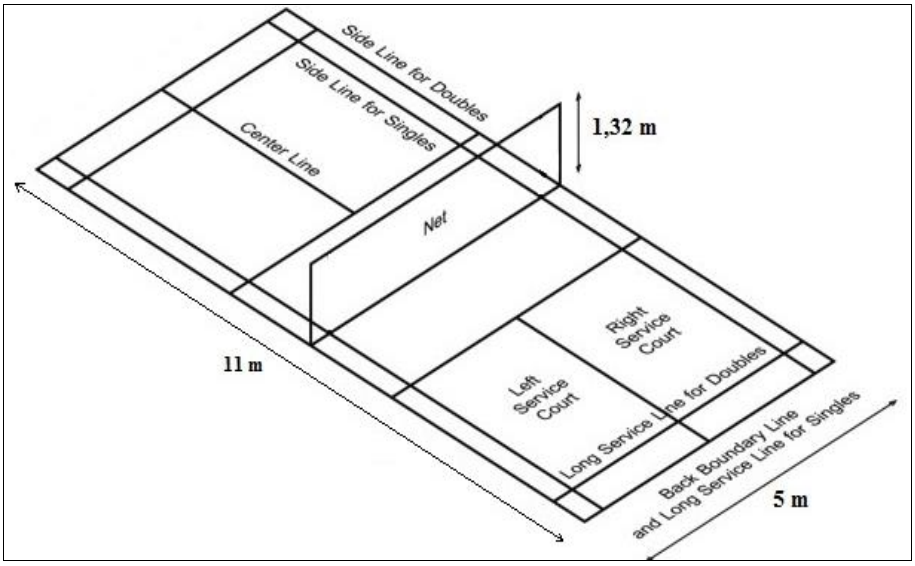

Fig 1: Initial product for field development and badminton net height for Students of SDN Sukodadi 02 Paiton District

This field has specifications

1. Rectangular in shape.
2. Has a length of 11 meters.
3. Has a width of 5 meters.
4. Has a net height of 1.32 meters.
5. The lines on the standard field are still used.

Product II

In this section, product II will be explained, namely the product produced after small group trials and review by badminton experts and physical education experts. An image of product II can be seen in figure 2.

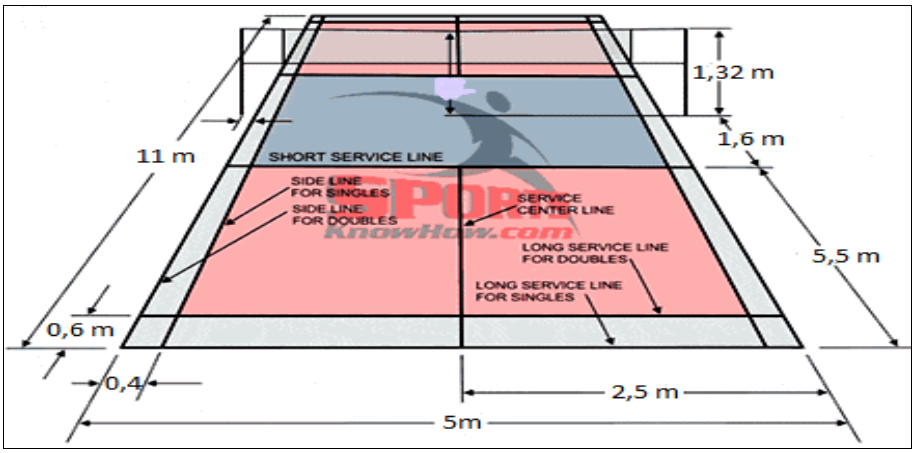

Fig 2: Product II Field Development and Badminton Net Height for Students of SDN Sukodadi 02 Paiton District

This field has specifications

1. Rectangular in shape.
2. Has a length of 11 meters.
3. Has a width of 5 meters.
4. It has a side line length for single play of 4.2 meters.
5. Has a net height of 1.32 meters.
6. The lines on the standard field are still used.
7. Has a front service line length (distance between the net and service line) of 1.6 meters.
8. Has a back service line length for doubles play of 1.3 m + 3.3 m = 4.6 meters.

Final product

The final product is a product that has been tested in a large group with 40 students as subjects. Images of the final product can be seen in figures 3 and 4.

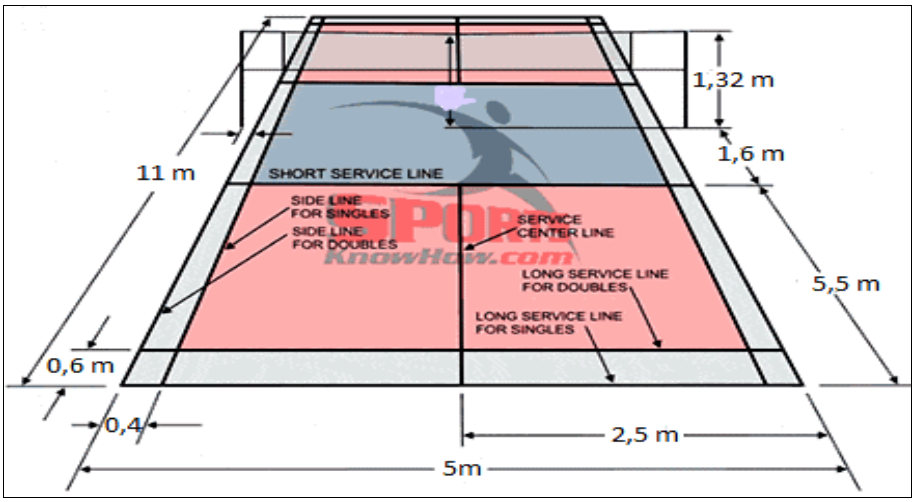

Fig 3: Final Product of Badminton Net Height and Field Development for Students of SDN Sukodadi 02 Paiton District

Fig 4: Final product for field development and badminton net height for Students of SDN Sukodadi 02 Paiton District

This field has specifications

1. Rectangular in shape.
2. Has a length of 11 meters.
3. Has a width of 5 meters.
4. It has a side line length for single play of 4.2 meters.
5. Has a net height of 1.32 meters.
6. The lines on the standard field are still used.
7. Has a line thickness of 40 mm.
8. Has a front service line length (distance between the net and service line) of 1.6 meters.
9. Has a back service line length for doubles play of 1.3 m + 3.3 m = 4.6 meters.
10. The navy blue field lines look contrasting and clear.

Discussion

Based on the results of the research conducted, the development of the badminton court and net height is in accordance with the anthropometric structure of grade 5 and 6 students at SDN Sukodadi 02, Paiton District, Probolinggo Regency. This is also in accordance with several theoretical studies regarding mini badminton games, although there are several differences (Brahms, 2010) [2]. According to Ivaanna Lie, for children aged 9 to 12 years: Length 11.88 meters Width 5.18 meters. The inside line of the badminton court becomes the outer line of the badminton court. The height of the mini badminton net is 140 centimeters. Based on empirical observations, the height of children aged 10 to 12 years is around 140 cm (Grice, 2008) [6]. Badminton field and net height development products for grade 5 and 6 students at SDN Sukodadi 02, Paiton District, Probolinggo Regency. This is an effort to overcome the problems students face when playing badminton (Barnamehei *et al*., 2021) [1]. It is hoped that with the development and appropriate height of badminton nets there will no longer be difficulties regarding court problems and the height of the net used.

Based on data from expert reviews and field trials, as well as observations during development, there were several revisions to the product being developed, including.

1. A badminton court of 11 m
2. Have a net height tolerance of ± 1 cm above or below.
3. Shuttlecocks use a shuttlecock that is suitable for the field, namely by testing it first before playing.

4. The front service line, the back service line and the service line for doubles play remain.
5. The number of players is fixed for singles and doubles games.
6. The line paint color is light sea blue.

In the following table, a comparison will be presented between the Nini badminton court and the badminton court developed by researchers.

Table 1: Comparison of the Ivanna Lie Mini Badminton Court with the Badminton Court Developed by Researchers

No.	Aspect	Ivanna Lie	Description
1.	Field Shape	Rectangle	Rectangle
2.	Field size	11,88 m X 5,18 m	11 m X 5 m
3.	Net height	1,40 m	1,32 m
4.	Subject	Children aged 9-12 years	Students in grades 5-6 elementary school

After carrying out revisions in accordance with the provisions, there are still several weaknesses in the revised product. Some of the weaknesses of the products being developed include.

1. Still requires evaluation and trials on larger and broader subjects.
2. There is still a need for further research regarding the effectiveness of the products being developed.

Apart from the weaknesses mentioned above, this product also has the following advantages. The field development product and net height include a badminton court of 11 m X 5 m and a net height of 1.32 m in accordance with the anthropometric structure. Field development products and net height which include a badminton court of 11 m Field and net height development products which include a badminton court of 11 m X 5 m and a net height of 1.32 m have never been implemented and tested in Indonesia. In making this product, clear subjects were used, namely 40 students in grades 5 and 6 of SDN Sukodadi 02, Paiton District, Probolinggo Regency, and as a comparison 40 students from the Physical Education Department.

Produk pengembangan lapangan dan tinggi net yang meliputi lapangan bulutangkis 11 m X 5 m dan tinggi net 1,32 m, berdasarkan penelitian jadi hasil dari produk dari penelitian ini dapat dipertanggungjawabkan. Alat ukur yang digunakan untuk segala aktivitas dalam penelitian ini telah ditera ulang oleh badan metrologi, jadi hasilnya valid. Produk pengembangan lapangan dan tinggi net yang meliputi lapangan bulutangkis 11 m X 5 m dan tinggi net 1,32 m bermanfaat bagi siswa sebagai bahan pengenalan terhadap permainan bulutangkis standar. Siswa sangat senang dengan adanya produk pengembangan lapangan dan tinggi net yang meliputi lapangan bulutangkis 11 m X 5 m dan tinggi net 1,32 m karena mereka dapat bermain bulutangkis dengan baik tanpa merasa takut akan luas lapangan dan ketinggian net. Produk pengembangan lapangan dan tinggi net yang meliputi lapangan bulutangkis 11 m X 5 m dan tinggi net 1,32 m bermanfaat bagi guru untuk digunakan sebagai bahan pembelajaran bulutangkis di SD.

Conclusion

It is absolutely necessary to develop badminton courts and nets for students in grades 5 and 6 of elementary school, based on research results, the size of the court that can be used, namely 11 m x 5 m and a net height of 1.32 m, is in accordance with the anthropometric characteristics of that age.

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