Blended-based massed and distributed training: a strategy for teaching volleyball skills in student-athletes

Bachtiar1,2,3ABCDE, Taufik Rihatno1,2ABCD, Samsudin1ABCDE, Firmasyah Dlis1ACD, James Tangkudung1ACD, Edi Setiawan2ACD, Yasep Setiakarnawijaya1ACDE, Firman Septiadi3ACD

1 Faculty of Sport Science, Universitas Negeri Jakarta, Indonesia
2 Faculty of Teacher Training and Education, Universitas Suryakancana, Indonesia
3 Faculty of Teacher Training and Education, Universitas Muhammadiyah Sukabumi, Indonesia

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Abstract

Background and purpose
Purpose: the lack of evidence on the effectiveness of blended-based massed and distributed training in volleyball resulting a gap, which became a focus in this study. This study aims to identify the effects of blended-based massed and distributed training on changes in student-athlete volleyball skills through mixed research methods.

Material and methods
This study applied mixed research methods and involved 60 female athletes who were active in volleyball from the Muhammadiyah University of Sukabumi (Indonesia). Participants were randomly allocated to the massed exercise, distributed exercise and control group. Quantitative instruments involved volleyball skill tests and qualitative instruments involved in-depth interviews. Quantitative data analysis included normality test, mean, standard deviation and ANOVA to assess differences of volleyball skills between massed, distributed and control groups. The size of effect in these three groups on volleyball skills was analyzed through the Cohen d. While qualitative data analysis was conducted through thematic analysis.

Results
This quantitative research found several results. First, there was no difference in volleyball skill scores between blended based massed and distributed training group and controls group before the experiment (p>0.05). Second, there was a difference in values between the blended-based massed and distributed group as well as control group after the experiment (p<0.05). Third, the effect size test showed that the blended-based massed and distributed groups have a moderate effect while the control group has a small effect on volleyball skills. While, in qualitative research agreed that blended-based massed and distributed training had advantages, weaknesses and impacts on volleyball skills.

Conclusions
This study concluded that this mixed research method was proven that blended based massed and distributed training have a positive effect for student athletes to learn every movement in volleyball skills.

Keywords: blended, massed, distributed, volleyball skills, physical education
Анотація
Бахтиар, Тауфік Рихатно, Самсудин, Фірмася Дліс, Джеймс Тангкудунг, Еді Сетіаван, Ясеп Сетіакарнавія, Фірман Септіаді. Змішані масові та розподілені тренування: стратегія навчання волейбольних навичок студентів-спортсменів

Обґрунтування і мета
Відсутність доказів ефективності змішаних масових і розподілених тренувань у волейболі, що призвело до прогалин, яка стала центром уваги в цьому дослідженні. Це дослідження спрямоване на виявлення ефектів змішаних масових і розподілених тренувань на зміни волейбольних навичок студентів і спортсменів за допомогою зміщаних методів дослідження.

Матеріал і методи
У цьому дослідженні застосовувалися змішані методи дослідження та брали участь 60 спортсменок, які активно займалися волейболом, з Університету Мухаммадії в Сукабумі (Індонезія). Учасники були випадковим чином розподілені на масову, розподілену та контрольну групи. Кількісні інструменти включали тести волейбольних навичок, а якісні інструменти включали глибинні інтерв’ю. Кількісний аналіз даних включав тест нормальності, середнє значення, стандартне відхилення та ANOVA для оцінки відмінностей волейбольних навичок між масовою, розподіленою та контрольною групами. Величина впливу цих трьох груп на волейбольні навички була проаналізована за допомогою Cohen d. У той час як якісний аналіз даних проводився через тематичний аналіз.

Результати
Це кількісне дослідження виявило декілька результатів. По-перше, не було різниці в показниках навичок гри у волейбол між групою змішаного масового та розподіленого тренування та контрольною групою до експерименту (p>0,05). По-друге, існувала різниця в значеннях між змішаною масовою та розподіленою групою, а також контролюючою групою після експерименту (p<0,05). По-третє, тест розміру ефекту показав, що змішані масові та розподілені групи мають помірний ефект, тоді як контрольна група має незначний вплив на волейбольні навички. У той час як якісне дослідження проводилося через тематичний аналіз.

Висновки
Цей змішаний метод дослідження підтвердив, що змішані масові та розподілені тренування позитивно впливають на навчання студентів-спортсменів кожному руху у волейбольних навичках.

Ключові слова: змішана, масова, розподілена, волейбольна майстерність, фізичне виховання

Аннотация
Бахтиар, Тауфік Рихатно, Самсудин, Фирмася Дліс, Джеймс Тангкудунг, Эди Сетіаван, Ясеп Сетіакарнавія, Фірман Септіаді. Смешанная массовая и распределенная тренировка: стратегия обучения волейбольным навыкам студентов-спортсменов

Обоснование и цель
Отсутствие доказательств эффективности смешанных массированных и распределенных тренировок в волейболе привело к пробелу, который стал предметом исследования. Это исследование направлено на выявление влияния смешанных массированных и распределенных тренировок на изменения в волейбольных навыках студентов-спортсменов с помощью смешанных методов исследования.

Материалы и методы
В этом исследовании применялись смешанные методы исследования, в нем приняли участие 60 спортсменок, занимающихся волейболом, из Университета Мухаммади в Сукабуми (Индонезия). Участники были случайным образом распределены в группу массовых упражнений, распределенных упражнений и контрольную группу. Количественные инструменты включали тесты навыков игры в волейбол, а качественные инструменты включали подробные интервью. Количественный анализ данных включал тест на нормальность, среднее значение, стандартное отклонение и дисперсионный анализ для оценки различий волейбольных навыков между массовыми, распределенными и контрольными группами. Величина влияния этих трех групп на волейбольные навыки была проанализирована с помощью шкалы Cohen d. При этом качественный анализ данных проводился посредством тематического анализа.

Результаты
Это количественное исследование дало несколько результатов. Во-первых, не было никакой разницы в оценках навыков волейбола между смешанной, массовой и распределенной тренировочной группой до эксперимента (p>0,05). Во-вторых, после эксперимента наблюдалась разница в значениях между массированной и распределенной группой на смешанной основе, а также контрольной группой (p<0,05). В-третьих, тест на размер эффекта показал, что смешанные групповые и распределенные группы имеют умеренный эффект, в то время как контрольная группа оказывает небольшое влияние на волейбольные навыки. В то время как качественные исследования пришли к выводу, что смешанные массовые и распределенные тренировки имеют преимущества, недостатки и влияние на волейбольные навыки.

Выводы
Этот смешанный метод исследования доказал, что смешанные массовые и распределенные тренировки оказывают положительное влияние на студентов-спортсменов, чтобы изучить каждое движение в навыках волейбола.

Ключевые слова: смешанные, массированные, распределенные, волейбольные навыки, физическое воспитание
Introduction

In several countries, the teaching system of physical education after the impact of the COVID-19 pandemic crisis had shown changes and involved technology usage [1, 2, 3]. Data reported that technology in teaching process of physical education had positive results, for example it can increase fun, engagement [4], motivation [5] and cognitive understanding, motor performance [6], until the role of technology was claimed to be able to assist lecturers in delivering all subject matter to student athletes optimally [7]. Thus, it was expected that the technology which was integrated into the physical education teaching process can support the improvement in learning outcomes after the COVID-19 pandemic.

Volleyball is one of the subjects in physical education which is currently popular among student athletes, because there are many competitive events currently being held in the world. According to Yudiana, Sucipto, Hidayat & Hambali [8], to become a successful player in volleyball, it must be supported by excellent performance and one of the aspects that support volleyball performance is skills [9]. Basically, volleyball skills were related to basic techniques of serving [10, 11], passing [12] and smash. If student-athlete has a good level of volleyball skills, they will have a greater potential to gain national and international achievements [13]. Meanwhile, low skills will make them difficult to beat opponents [14]. This was also reported by previous studies that the main factor that must be fostered and developed in student athletes was volleyball skills [15]. Given the importance of volleyball skills for student athletes [16], an appropriate method was needed, namely through a blended-based massed and distributed training method.

The massed method is a training that requires student athletes to learn volleyball skills continuously without rest. This was also explained by Nugroho, Hidayatullah, Doewes & Purnama (17), that in the massed method process, student-athletes performed volleyball skill movements repeatedly and without rest. Meanwhile, the distributed method was the opposite of massed, this training applied rest period between execution and to alternate the player [18]. Previous studies had proven that the massed and distributed methods can improve forehand drive skills in tennis [19]. While the blended-based massed and distributed method was carried out face to face and online. Basically blended was a training system that popular in worldwide sport [20, 21]. The benefits of using blended training have been well documented internationally [22, 23, 24], for example, it can improve problem solving abilities, long jump techniques [25], physical skills to academic achievement [26].

Research on the massed and distributed methods had been well documented, but the lack of evidence of the effectiveness of the massed and distributed training methods on improving volleyball skills has created a gap in this study, because previous research only focused on tennis [19, 18, 17]. In addition, this study tries to present a novelty in identifying the effects of blended-based massed and distributed training methods through mixed research methods. Thus, this study aims to investigate the effects of blended-based massed and distributed training methods towards the improvement of student-athlete volleyball skills through mixed research methods.

Material and methods

Participants

Sixty female athletes from the Muhammadiyah University of Sukabumi (Indonesia) were selected and involved in this study. Participants were randomly allocated to experimental group 1, which carried out a blended-based massed exercise program (age= 19.05±1.0 years, weight= 57.55±2.6 kg, height= 1.57±2.9 cm), experimental group 2 received blended-based distributed training (age= 19.70±1.3 year, weight = 58.65±2.2 kg, height = 1.59±3.0 cm) and control (age= 20.00±1.1 years, weight= 59.05±2.7 kg, height= 1.59±3.2 cm). In order to keep the identity of participants in accordance with the guidelines of the World Medical Association Code of Ethics (Helsinki Declaration for Humans), the researcher did not provide the initials of "participant". To be clearer about the distribution of participants in this study is presented in Fig. 1.

Research methods

This study used mixed research methods. Basically, mixed methods research is a combination of quantitative and qualitative. According to previous studies, this research was able to evaluate the effect of the independent variables towards dependent variable quantitatively and qualitatively [27, 28, 29]. Quantitative research was carried out using experimental methods while qualitative research was carried out through in-depth interviews.
Fig. 1. The distribution flow of research participants

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**Instrument**

**Instrument quantitative**

Instruments for measuring volleyball skills in this study include:

Serving test. Participants stood behind the end line of the volleyball court. Then, the participant served (with or without jumping) directed to the target area and got score from 1 to 3 on the field. Participants were given 10 chances. The scoring system was based on the number of balls that entered the target area. If the ball hit the net or went out of the field, the score was 0.

Forearm pass test. The participants stood up and after the whistle sounds the participants passing to the target area and got score from 1 to 3 on the field [13]. Participants were given 10 chances. The scoring system was based on the number of balls that entered the box. If the ball hit the net or went out of the field, the score was 0.

One-hand spike test [13]. Participants stood in an attack position on the left side of the field. Participants spike 10 times at the target area and got score from 1 to 3 on the field. The scoring system was counted based on the number of ball that entered the target area. If the ball hit the net or went out of the field, the score was 0.

**Instrument qualitative**

The instrument in qualitative research adopted from previous studies [30], namely a 30-minute in-depth interview test with participants regarding the strengths, weaknesses and impacts of using blended-based massed and distributed training methods on changes in their skills.
Procedures

This research was conducted from December 2022 to January 2023 at the Muhammadiyah University of Sukabumi sports field (Indonesia) with approval number: 201.80/UMMI/UN/LL/2022. In carrying out all the activities in this study the researchers followed the guidelines of the World Medical Association Code of Ethics (Helsinki Declaration for Humans). On December 26, 2022, quantitative research was carried out through experiments, the first activity was a volleyball skill test. On December 28, 2022 the intervention program was carried out, the experimental group 1 carried out massed-based blended exercises, experiment 2 carried out distributed-based blended exercises and the control group did not carry out any program, these activities were carried out until January 20 2023. The last meeting was on January 23 2023 all participants carried out volleyball skills test. All these activities were carried out at 09.00 am until finished.

Qualitative research through in-depth interviews was carried out on January 25 2023 in the class room at the Muhammadiyah University of Sukabumi. Interviews were conducted individually using Indonesian and recorded via video. In addition, the interviews only focused on participants from the massed and distributed groups. The results of the interviews were analyzed by 4 experts in sports training methods and physical education.

**Intervention program**

Blended based massed and distributed training was held 3 days a week, namely on Monday, Wednesday and Friday. Offline massed and distributed training was carried out in the field. Meanwhile, online meetings were carried out via a zoom meeting platform, the participants and trainers stayed at their respective houses. The intervention program was presented in Table 1.

**Intervention program**

<table>
<thead>
<tr>
<th>Blended based massed training</th>
<th>Blended based distributed training</th>
<th>Meeting system</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Warm-up for 3 minutes</td>
<td>• Warm-up for 3 minutes</td>
<td></td>
</tr>
<tr>
<td>• The trainer demonstrated volleyball skills including serving, passing and spikes. Each technique was performed for 10 minutes.</td>
<td>• The trainer demonstrated volleyball skills including serving, passing and spikes. Each technique was conducted for 10 minutes.</td>
<td></td>
</tr>
<tr>
<td>• Student athletes performed volleyball skills training in serving, passing and spikes. Each technique was performed for 15 minutes and without rest</td>
<td>• Student athletes performed volleyball skills training in serving, passing and spikes. Each technique was conducted in 15 minutes and rests for 3 minutes.</td>
<td></td>
</tr>
<tr>
<td>• Cooling down for 2 minutes.</td>
<td>• Cooling down for 2 minutes.</td>
<td>Offline</td>
</tr>
</tbody>
</table>

| • All activities in this session were carried out online via zoom meeting platform. | • All activities in this session were carried out online via zoom meeting platform. |                |
| • Warm-up for 5 minutes. | • Warm-up for 5 minutes. |                |
| • The trainer demonstrated volleyball skills including serving, passing and spikes. Each technique was conducted for 15 minutes. | • The trainer demonstrated volleyball skills including serving, passing and spikes. Each technique was conducted in 15 minutes. |                |
| • Student athletes performed volleyball skills in serving, passing and spikes. Each technique was conducted for 20 minutes and without rest | • Student athletes performed volleyball skills training in serving, passing and spikes. Each technique was conducted for 20 minutes and rests for 3 minutes. |                |
| • Cooling down for 5 minutes. | • Cooling down for 5 minutes.      | Online          |

Tabel 1
Data analysis

Quantitative data analysis. Volleyball skills test result data was analyzed through IBM SPSS version 25.0 (Armonk, NY: IBM Corp). Normality test was conducted using Kolmogorov-Smirnov (p>0.05). The mean and standard deviation was analyzed through statistical descriptive analysis. The difference in the score of volleyball skills between the massed-based blended, distributed-based blended and control training groups was analyzed through ANOVA. Meanwhile, to find out the size of effect among these groups, it was analyzed through the effect size (Cohen d). Effect size was interpreted using cutoff values of 0.2 (small effect), 0.5 (medium effect) and 0.8 (large effect) [31]. The significance level was p<0.05.

Qualitative data analysis. Data from in-depth interviews with participants was analyzed through qualitative thematics, namely: interview recording, coding and categorizing into 3 themes [28]. Theme 1 related to the advantages of blended-based massed and distributed training, theme 2 related to the weakness of blended-based massed and distributed training and theme 3 relates to the effects of blended-based massed and distributed training on student-athlete volleyball skills.

Results

Table 2 describes that all groups has normal distribution (p>0.05). Table 3 shows that there is no difference in the scores of volleyball skills between three training groups before the experiment (p>0.05). While Table 4 proves there was a difference in values between the blended-based massed and distributed as well as control group after the experiment (p<0.05). The effect size test (Cohen d) shows that massed training has a moderate effect (serve test d=0.65, forearm pass test d=0.61, one-hand spike test d=0.56), similar with distributed training (serve test d= 0.70, forearm pass test d=0.67, one-hand spike test d=0.63). However, the control group has a small effect (serve test d=0.25, forearm pass test d=0.30, one-hand spike test d=0.20) (Table 5).

<table>
<thead>
<tr>
<th>Normality testing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
</tr>
<tr>
<td>Volleyball skills</td>
</tr>
<tr>
<td>Serve test</td>
</tr>
<tr>
<td>Forearm pass test</td>
</tr>
<tr>
<td>One-hand spike test</td>
</tr>
</tbody>
</table>

Note. n: Participant, p>0.05

<table>
<thead>
<tr>
<th>Differences in volleyball skill scores between these three training groups before the experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
</tr>
<tr>
<td>Volleyball skills</td>
</tr>
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</tr>
<tr>
<td>Forearm pass test</td>
</tr>
<tr>
<td>One-hand spike test</td>
</tr>
</tbody>
</table>

Note. n: Participant, X: Mean, S: Standard deviation, p<0.05
Differences in the volleyball skill scores between these three training groups after the experiment

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Unit</th>
<th>Massed Group</th>
<th>Distributed Group</th>
<th>Control Group</th>
<th>Between-group comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serve test</td>
<td>Points</td>
<td>60</td>
<td>17.70±17.7</td>
<td>18.00±2.97</td>
<td>14.25±1.37</td>
</tr>
<tr>
<td>Forearm pass test</td>
<td>Points</td>
<td>60</td>
<td>17.20±2.82</td>
<td>19.25±2.24</td>
<td>12.65±2.20</td>
</tr>
<tr>
<td>One-hand spike test</td>
<td>Points</td>
<td>60</td>
<td>13.15±1.56</td>
<td>13.40±1.75</td>
<td>6.05±0.82</td>
</tr>
</tbody>
</table>

Note: n: Participant, X: Mean, S: Standard deviation, p<0.05

Effect size test results (Cohen d)

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Unit</th>
<th>Massed Group</th>
<th>Distributed Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serve test</td>
<td>Points</td>
<td>60</td>
<td>0.65</td>
<td>0.70</td>
</tr>
<tr>
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<td>One-hand spike test</td>
<td>Points</td>
<td>60</td>
<td>0.56</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Note: n: Participant, d: Effect Size

The results of qualitative research in research obtained the following findings:

**Theme 1: The advantages of blended-based mass and distributed training**

The first theme relates to the advantages of using blended-based massed and distributed training which must be revealed through the perceptions of the participants (student-athletes). In this case the participants gave the perception that:

"From our point of view, the advantage of blended-based massed training was first, we can learn movements such as serves, passing and spikes both offline and online with a longer duration, because there was no rest time. Second, continuous practice (drill) makes it easier for us to remember and learn all volleyball skills (Results of in-depth interviews with 10 massed group participants). Meanwhile, the advantage of blended-based distributed training is that participants can rest first to prepare their energy for the next exercise so they can perform more optimal" (Results of in-depth interviews with 10 participants in the distributed group).

We agree that both trainings have their respective advantages, for example conducted massed training without rest periods allowed us to learn many movements in a short time (Results of in-depth interviews with 10 participants in the massed group). Meanwhile, distributed training by implementing rest periods can restore our energy to prepare for the next exercise and avoid overtraining (Results of in-depth interviews with 10 participants in the distributed group).

**Theme 2: Weakness of blended-based mass and distributed training**

The second theme related to the weakness of implementing blended-based massed and distributed
training which was an important point to be known through the perceptions of the participants. Some participants argued that:

“Personally, we think that the weakness of blended-based massed training was their effect to us namely significant fatigue, because we were required to train continuously without rest. Our energy was drained in this training” (Results of in-depth interviews with 10 participants in the massed group).

The weakness of blended-based distributed training was we forgot the movement that had been learned because of long rest periods” (Results of in-depth interviews with 10 participants in the distributed group).

The main weakness of massed training was it can induce excessive fatigue which cause we did not optimal in learning volleyball skills (Results of in-depth interviews with 10 participants in the massed group). Then the weakness of distributed-based training on a blended basis was too long a break can cause boredom, so the next exercise was not taken seriously (Results of in-depth interviews with 10 participants in the distributed group).

Theme 3: Effects of blended-based massed and distributed training on volleyball skills

The last theme in this qualitative research was related to the effects or impacts caused by blended-based massed and distributed training on volleyball skills. In this case all participants revealed that:

"We all agreed that even though massed and distributed exercises had their weakness, we did not expect that our volleyball skills could improve better than before" (Results of in-depth interviews with participants in the massed and distributed groups).

Discussion

Our research aims to investigate the effect of blended-based massed and distributed training methods on the improvement of student-athlete volleyball skills through mixed methods research.

In quantitative research, there were two main findings. First, there was no difference in the scores of volleyball skills between three groups of training methods before the experiment, but there were differences after the experiment. Second, blended-based massed and distributed training has a moderate effect on volleyball skills, but the control group has a small effect.

The volleyball skills for student athletes in the blended based massed and distributed groups showed an improvement because both training methods have their respective advantages. For example, massed training with the concept of continuous repetition of movements without rest periods was the main strength, which can support athlete to understand the skills. Similar situation was explained by Fuentes-Garcia, Pulido, Morales & Menayo [18], training that was carried out continuously can affect the results of learning motion. Meanwhile, distributed training has advantages in terms of taking advantage of rest breaks to analyze the movements that have been learned, such as which movements are right and wrong and can prepare energy to face the next exercise [32]. The results of this study were also reinforced by previous research which reported that both methods have positive effectiveness in teaching hitting skills in tennis [17]. Other research also confirmed that even though massed and distributed training have significantly different scores, both have proven effective in increasing the ability to memorize a skill [33]. Nurcahya, Kusumah & Nurmansyah [19], showed similar results, 20 students showed an improvement in tennis skills after participating in both massed and distributed training programs.

Meanwhile, the qualitative findings through in-depth interviews obtained perceptions of the strengths, weaknesses and impacts of blended based massed and distributed. According to student athletes, the advantages of blended-based massed training were allowed them to learn movements such as serves, passing and spikes in a longer duration both offline and online [34], because there was no rest, continuous training also has the potential facilitated them to memorize and learn all volleyball skills. Meanwhile, the weakness was the student-athletes experienced over-fatigue. In addition, according to them, this training can support student athletes to learn volleyball skills with a better results. According to student athletes, blended-based distributed training had advantages to avoid overtraining and resting beforehand can help athletes to restore energy for the next training session and optimize their performance. Then, according to them, the weakness of distributed-based blended training was long rest periods cause the athlete forgot the movements that had been learned. In addition, according to them, this training has a significant impact on learning volleyball skills.
Thus, the uniqueness and novelty found in this study are: (i) this research has been proven to show that massed and distributed training has effectiveness in increasing student-athlete volleyball skills based on quantitative and qualitative research findings, while the differences in the findings of previous studies have only been proven statistically quantitatively research only [17, 18], (ii) another novelty finding is that this study proves that online and offline-based massed and distributed training both have effectiveness in improving student-athlete volleyball skills whereas previous studies were only conducted offline, (iii) and the latest novelty finding is that this study uses effect size analysis to assess how much effect massed and distributed training has on the volleyball skills of students-athletes whereas previous studies did not use this analysis [19].

**Conclusions**

Based on the quantitative and qualitative results and findings, we concluded that blended-based massed and distributed exercises both have a positive effect in teaching volleyball skills to student athletes. However, similar with other studies, this study has limitations, namely in terms of participants (student-athletes) involved in this study was collected from one type of sport, namely volleyball. Thus, it is suggested for future research to investigate blended based massed and distributed training using other types of sports such as martial arts, water sports or individual sports. This research contributes as important information for coaches and athletes around the world about the positive effects of blended-based massed and distributed training on volleyball skills, so it can be applied to support athlete in obtaining achievement in the future.

**Conflict of interest**

All researchers in this study stated that there was no conflict of interest.

**References**


Samsudin
samsudin@unj.ac.id
https://orcid.org/0000-0003-1565-4202
Faculty of Sport Science
Universitas Negeri Jakarta, Indonesia

Firmansyah Dlis
firmansyahdlis@unj.ac.id
https://orcid.org/0000-0002-2799-9745
Faculty of Sports Science, Universitas Negeri Jakarta
Jakarta Timur, Daerah Khusus Ibukota Jakarta, Indonesia

James Tangkudung
amestangkudung@unj.ac.id
https://orcid.org/0000-0002-6855-2173
Faculty of Sport Science
Jakarta Timur, Daerah Khusus Ibukota Jakarta, Indonesia

Edi Setiawan
edisetiawanmpd@gmail.com
https://orcid.org/0000-0001-7711-002X
Faculty of Teacher Training and Education, Universitas Suryakancana
Cianjur, Jawa Barat, Indonesia

Yasep Setiakarnawijaya
yasep.s@unj.ac.id
https://orcid.org/0000-0002-5105-5007
Faculty of Sport Science
Jakarta Timur, Daerah Khusus Ibukota Jakarta, Indonesia

Firman Septiadi
septiadifirman@ummi.ac.id
https://orcid.org/0000-0002-8486-4070
Faculty of Teacher Training and Education, Universitas Muhammadiyah Sukabumi
Sukabumi, Jawa Barat, Indonesia

Інформація про авторів

Бахтіар
bachtiar 9904918008@mhs.unj.ac.id
https://orcid.org/0000-0002-8343-2997
Факультет спортивних наук, Університет Негері Джакарти
Джакарта Тимур, Даера Хусус Ібукота Джакарта, Індонезія

Тауфік Ріхатно
trihatno@unj.ac.id
https://orcid.org/0000-0002-2296-3217
Факультет спортивних наук, Університет Негері Джакарти
Джакарта Тимур, Даера Хусус Ібукота Джакарта, Індонезія

Самсудін
samsudin@unj.ac.id
https://orcid.org/0000-0003-1565-4202
Факультет спортивних наук
Університет Негері Джакарта, Індонезія
Фирмансях Дліс
firmansyahdlis@unj.ac.id
https://orcid.org/0000-0002-2799-9745
Факультет спортивных наук, Университет Негери Джакарта
Джакарта Тимур, Даэра Хусус Ибукота Джакарта, Индонезия

Джеймс Тангкулунг
amestangkudung@unj.ac.id
https://orcid.org/0000-0002-6855-2173
Факультет спортивных наук
Джакарта Тимур, Даэра Хусус Ибукота Джакарта, Индонезия

Еді Сетіаван
edisetiawanmpd@gmail.com
https://orcid.org/0000-0001-7711-002X
Факультет подготовки вчителей и освіти, Университет Сурьяканкана
Сіанджур, Джава Барат, Индонезия

Ясеп Сетіакарнавія
yasep.s@unj.ac.id
https://orcid.org/0000-0002-5105-5007
Факультет спортивных наук
Джакарта Тимур, Даэра Хусус Ибукота Джакарта, Индонезия

Фірман Септіаді
septiadifirman@ummi.ac.id
https://orcid.org/0000-0002-8486-4070
Факультет подготовки вчителей и освіти, Университет Мухаммадії Сукабумі
Сукабумі, Джава Барат, Индонезия

Информация об авторах

Бахтиар
bachtiar_9904918008@mhs.unj.ac.id
https://orcid.org/0000-0002-8343-2997
Факультет спортивных наук, Университет Негери, Джакарта
Джакарта Тимур, Даэра Хусус Ибукота Джакарта, Индонезия

Тауфик Рихатно
trihatno@unj.ac.id
https://orcid.org/0000-0002-2296-3217
Факультет спортивных наук, Университет Негери, Джакарта
Джакарта Тимур, Даэра Хусус Ибукота Джакарта, Индонезия

Самсудин
samsudin@unj.ac.id
https://orcid.org/0000-0003-1565-4202
Факультет спортивных наук
Университет Негери Джакарта, Индонезия

Фирмансях Дліс
Firmansyahdlis@unj.ac.id
https://orcid.org/0000-0002-2799-9745
Факультет спортивных наук, Университет Негери, Джакарта
Джакарта Тимур, Даэра Хусус Ибукота Джакарта, Индонезия
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