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Digital Technology Base Assessment In Higher Physical Education Learning

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ABSTRACT

This study aims to analyze the body composition profiles of university students using digital technology and examine its implications for physical education assessment. In the context of digital transformation in higher education, conventional assessment methods based on body mass index (BMI) are considered insufficient to comprehensively reflect students' physical fitness. This study used a descriptive cross-sectional design involving 90 university students enrolled in a compulsory physical education course. Data were collected using a multi-frequency Bioelectrical Impedance Analysis (BIA) device to measure body composition parameters, including weight, height, skeletal muscle mass, body fat mass, BMI, and body fat percentage. Additional data were obtained through a digital platform for self-reporting and verification. Descriptive statistical analysis was performed using IBM SPSS. The results showed that the average BMI of participants was within the normal category (22.33 ± 4.60 kg/m²), while body fat percentage (22.57 ± 8.11%) and skeletal muscle mass (26.60 ± 5.17 kg) showed considerable variation. These findings indicate that BMI alone is insufficient to accurately describe students' physical condition, particularly in identifying body composition imbalances. Therefore, the integration of BMI-based digital technology into physical education assessments provides a more objective and comprehensive evaluation of students' physical fitness.

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INTRODUCTION

Digital transformation in global education has reached a crucial point where the integration of information technology is no longer seen as a peripheral tool, but rather as a core element in the modern pedagogical structure (Risnawati et al., 2025). Entering the era of Society 5.0, higher education institutions are required to produce graduates who are not only intellectually superior, but also have health awareness supported by accurate physical data literacy (Zhong et al., 2025). In the context of Physical Education (PE), the shift from the traditional paradigm focused on athletic performance to an evidence-based holistic fitness paradigm requires assessment instruments capable of capturing physiological data in real-time and objectively (Chai et al., 2025).

Globally, the use of artificial intelligence (AI) and wearable technologies in physical education assessments has shown a transformative impact. Report of (*OECD Digital Education Outlook 2026*, 2026) notes that the use of AI-based assessment tools can help teachers provide more personalized and adaptive feedback, thereby significantly increasing students' motivation to learn. In developed countries, more than 67% of educational institutions have adopted digital platforms to monitor students' physical activity, which has been shown to reduce subjectivity in grading and increase the transparency of the evaluation process (Harsanti et al., 2025). However, this transition has not been without obstacles; challenges related to data privacy, infrastructure inequalities, and teacher competency readiness remain central issues in international academic discussions (Rufi'i et al., 2026).

In Indonesia, digital transformation policies are strengthened through the launch of the National Strategy for Artificial Intelligence 2020-2025 and the implementation of the Independent Curriculum which emphasizes flexibility and the use of technology in learning (Indarto et al., 2025). The implementation of e-learning technology and internet-based applications in the physical education curriculum is considered a subtle improvement that provides space for students to explore their physical potential independently (Dameria & Yudhistira, 2025). In fact, research in the last five years has shown that the use of digital media in physical education learning at universities can increase student engagement by up to 70%, especially through interactive discussions and self-monitoring using fitness apps (Nurafiati & Angriawan, 2025). However, the effectiveness of this integration is often hampered by infrastructure disparities between urban and disadvantaged areas, as well as low digital literacy among Physical education educators (Runisah et al., 2026).

The urgency of using digital technology in physical assessment is becoming increasingly evident considering the current lifestyle profile of students who tend to be sedentary, especially in study programs with a high cognitive load such as Artificial Intelligence. During the pandemic and its transition, students' physical activity decreased drastically due to an increase in screen time, which resulted in weight gain and a decrease in core muscle strength (Raiyawan et al., 2021). Without an assessment system that is able to detect health risk profiles early, fitness interventions in Physical Education and Fitness (Penjasbug) courses will not be on target (Cepková et al., 2025). Conventional weight-based assessments or BMIs often fail to identify the phenomenon of "normal-weight obesity," in which

individuals have a healthy body mass index but have a body fat percentage that is harmful to metabolic health (Mudarra-García et al., 2025).

The current research gap shows that although many studies have evaluated the use of technology in primary and secondary schools, there is still limited research that specifically analyzes the efficacy of Bioelectrical Impedance Analysis (BIA) technology as an objective assessment standard for students in Indonesian universities (Sahbana Ridha, 2025). Most of the literature still focuses on the motivation or perception aspects of technology, while empirical data on the relationship between digital body composition and student academic achievement are still very scarce (Chang, 2025). There is an urgent need to map how objective physical data collected through digital technologies can be transformed into equitable, science-based learning outcome assessment metrics (Ferawati, 2025).

Based on this background, through the use of data from BIA-based body composition measurements, this study aims to provide a comprehensive overview of the physical profile of students in the digital era and the challenges that arise in the process of independent assessment data input. The novelty of this study lies in the use of AI specialist student population data as a representation of groups with high sedentary risk in the digitized physical education assessment framework.

METHODS

This study uses a descriptive survey design with a cross-sectional approach to analyze the data of students' physical assessment results through digital technology devices. This study focuses on the evaluation of body composition parameters as the main indicator in the learning outcome assessment process in the Physical Education and Health course at the university level.

Participants and Sampling

The population of this study included a sample of 90 students of the mechanical engineering study program who took the university's compulsory course "Physical Education and Fitness" at the State University of Surabaya. Students were selected through *purposive sampling techniques.* The demographic characteristics of the sample showed the gender dominance of males as much as 87.8% (n=79) and females as much as 12.2% (n=11), which reflects the typical gender distribution in the study program. The average age was 18 – 22 years.

Instruments

The main data were collected using the multifrequency Bioelectrical Impedance Analysis (BIA) device of the in-body model. The device uses 8-point tactile electrode technology to measure resistance and reactance in five body segments (right arm, left arm, torso, right leg, and left leg) with current flow at various frequencies (minimum 50 kHz). The physical parameters measured include: Weight (kg), Height (cm), Selective Muscle Mass (kg), Body Fat Mass (kg), Body Mass Index (kg/m2), and Percent Body Fat (%).

The validity of this BIA device has been verified in various clinical and sports studies, showing a very strong correlation ($r > 0.90$) with the gold standard Dual-energy X-ray Absorptiometry (DXA) for the measurement of lean free mass and fat mass. In addition to physical data, this study uses the Google Forms platform for synchronization of personal identity data and uploading photo evidence of measurement as a form of data verification. The final assessment of learning outcomes (Evaluation Points) is calculated through the university's LMS based on an algorithm that combines attendance, assignments, and test performance.

Procedures

The data collection procedure is carried out systematically in a controlled campus fitness laboratory environment to minimize disruptive variables. The stages of the procedure are as follows:

1. Pre-Measurement Preparation: participants were instructed not to eat or drink at least 2 hours before the test, empty the bladder, and not to engage in strenuous physical activity in the last 24 hours to maintain the stability of the body's hydration status.
2. Anthropometric Verification: height was measured using a manual stadiometer with a precision of 0.1 cm. Students were then asked to remove metal objects and footwear to ensure direct contact with the electrodes of the BIA device.
3. BIA Measurement Protocol: Participants stand upright on the leg electrodes of the BIA device. Holding the electrode in the hand with the arm forms a 30-degree angle to the body to ensure an even flow of current. The measurement process takes place automatically for approximately 60 seconds.
4. Digital Data Entry: Printed results from the BIA device are photographed and the numerical data is independently input by the student into a digital form as part of an individual report assignment.
5. Learning Outcome Synchronization: At the end of the semester, student evaluation points are pulled from the academic database to be linked to the initial physical profile data.

Data Analysis

Data analysis was carried out using IBM SPSS Statistics software version 26.0 to ensure the accuracy of statistical calculations. Before the main analysis, an intensive data cleaning procedure was carried out to handle student input anomalies. After that, descriptive statistics were run.

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RESULTS

Descriptive statistical analysis was performed to describe the characteristics of the study participants. A total of 90 participants were analyzed in this study. The average age of the participants was 19.21 ± 0.79 years with a range of 18 to 22 years. The average height and weight were 167.4 ± 6.50 cm, and 62.98 ± 14.82 kg, respectively.

The average skeletal muscle mass was 26.60 ± 5.17 kg, while the body fat mass was 15.10 ± 8.34 kg. The average Body Mass Index (BMI) value was 22.33 ± 4.60 kg/m2 indicating a normal weight category. The average body fat percentage was 22.57 ± 8.11%.

The average performance score of the participants was 68.46 ± 6.14 with a score range between 54 to 87. These results showed a moderate variation in the physical characteristics and performance of the participants.

Table 1. Results of statistical tests

	N	Min	Max	Mean	SD
Age	90	18	22	19.21	.786
Height (Cm)	90	149.0	182.0	167.456	6.5040
Weight (Kg)	90	39	103	62.98	14.815
Skeletal Muscle Mass (Kg)	90	14	37	26.60	5.165
body fat mass (Kg)	90	4	41	15.10	8.338
Body Mass Index (Kg/m²)	90	15	37	22.33	4.599
Percent Body Fat (%)	90	8	43	22.57	8.111
Performance Score	90	54.0	87.0	68.456	6.1446

DISCUSSION

This study aims to analyze the body composition profile of students using Bioelectrical Impedance Analysis (BIA) technology in the context of digital-based physical education assessment (Samouda & Langlet, 2022). The main findings showed that in general, students were in the category of normal body mass index (BMI) (22.33 ± 4.60 kg/m²), but had considerable variations in body fat percentage (22.57 ± 8.11%) and skeletal muscle mass (26.60 ± 5.17 kg). This indicates that BMI-based assessments alone are not representative enough to comprehensively describe students' physical fitness conditions (Setiawan & Lontoh, 2023).

Interpretively, the fairly high variation in body composition even though BMI is classified as normal can be explained through the concept of normal-weight obesity, where individuals have a normal weight but a relatively high percentage of body fat (Yogesh et al., 2024). This phenomenon is common in populations with sedentary lifestyles, such as students of technology-based study programs, who tend to have low physical activity (Indah et al., 2026). Additionally, low daily physical activity can affect the balance between muscle mass and body fat, impacting overall fitness quality (Utomo et al., 2025).

When compared to previous research, these results are in line with studies that show that the use of digital technologies such as BIA is able to provide a more accurate picture of body composition compared to conventional methods based on simple anthropometry (Lee et al., 2023; Parker et al., 2022). These findings also reinforce previous research that stated that the integration of technology in physical education can improve the objectivity of assessments and provide more detailed data for individual fitness analysis. However, the study also expands the literature by highlighting the importance of the implementation of such technology in the context of higher education, which has been relatively limited compared to the school level (Granić, 2022).

In terms of mechanism, the use of BIA devices allows for measurements based on the body's electrical resistance to distinguish fat mass and fat-free mass more precisely (Toselli et al., 2021). This provides an advantage in the evaluation process because it is able to identify body components that contribute to students' physical performance. In addition, the integration of digital systems through independent data input also reflects a technology-based learning approach that encourages active student involvement in the self-evaluation process (self-monitoring) (Ali et al., 2021; Hernani et al., 2025).

The practical implications of this research are quite significant. In the context of physical education in college, the use of BIA technology can be an alternative to a more objective, transparent, and data-based assessment system (Branco et al., 2023). For lecturers or teachers, these results can be used as a basis for designing more personalized and targeted fitness interventions (Fadillah & Indahwati, 2026). In addition, for educational institutions, the integration of digital technology in assessments can support the transformation towards an adaptive and evidence-based learning system (Hamdi et al., 2022).

However, this study has several limitations. First, the cross-sectional research design does not allow the analysis of the causal relationship between body composition and students' academic performance. Second, the sample size that is limited to one study program can reduce the generalization of research results. Third, the process of independent data input by students has the potential to cause bias or reporting errors, even though verification has been carried out through photo documentation.

Based on these limitations, further research is recommended to use longitudinal design to see changes in body composition over time and their relationship with academic performance. In addition, it is necessary to expand the sample across study programs or universities to increase external validity. The development of an automated data input system is also an important recommendation to minimize errors and improve data accuracy in a digital-based assessment system.

CONCLUSION

This study shows that the use of Bioelectrical Impedance Analysis (BIA) technology in physical education assessment is able to provide a more comprehensive picture of student body composition compared to conventional approaches based on body mass index (BMI). Although the majority of students are in the normal BMI category, significant variations were found in body fat percentage and skeletal muscle mass, which indicates a potential body composition imbalance that is not detected through a simple assessment method.

These findings confirm that the integration of digital technology in the physical education learning evaluation process can increase the objectivity, accuracy, and depth of analysis of students' physical conditions. Practically, this approach allows teachers to design more targeted and data-driven fitness interventions, as well as encourage students to be more active in monitoring their physical condition.

For further research, it is recommended to develop a longitudinal design to evaluate changes in body composition over time, as well as the integration of an automated data input system to improve the validity and reliability of data in digital technology-based assessments.

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CONFLICT OF INTEREST

The authors declare there is no conflict of interest.

REFERENCES

Ali, H. I., Attlee, A., Alhebshi, S., Elmi, F., Al Dhaheri, A. S., Stojanovska, L., El Mesmoudi, N., & Platat, C. (2021). Feasibility study of a newly developed technology-mediated lifestyle intervention for overweight and obese young adults. *Nutrients*, *13*(8). https://doi.org/10.3390/nu13082547

Branco, M. G., Mateus, C., Capelas, M. L., Pimenta, N., Santos, T., Mäkitie, A., Ganhão-Arranhado, S., Trabulo, C., & Ravasco, P. (2023). Bioelectrical Impedance Analysis (BIA) for the Assessment of Body Composition in Oncology: A Scoping Review. In *Nutrients* (Vol. 15, Number 22). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/nu15224792

Cepková, A., Cepka, R., Šooš, Ľ., Honz, O., Uvaček, M., Žiška, J., & Zemková, E. (2025). Cluster analysis as an effective tool for identifying physical fitness in students: the basis for an innovative approach to optimizing physical education in the university environment. *Frontiers in Physiology*, *16*. https://doi.org/10.3389/fphys.2025.1634125

Chai, H., Li, R., Xue, Q., Liang, J., Xue, R., Xiao, S., Jiang, M., & Wang, Q. (2025). Digital Transformation in Physical Education: A Bibliometric Analysis of Global Trends, Hotspots, and Future Directions Through CiteSpace. In *SAGE Open* (Vol. 15, Number 4). SAGE Publications Inc. https://doi.org/10.1177/21582440251395582

Chang, C. (2025). Construction of Physical Education Teaching Evaluation System in Colleges and Universities Under the Background of Big Data Application. *International Journal of Web-Based Learning and Teaching Technologies*, *20*(1). https://doi.org/10.4018/IJWLTT.373315

Dameria, F. D., & Yudhistira, D. (2025). Peran Teknologi untuk Analisis Performa Atlet Bulutangkis Disabilitas Intelektual: Special Olympic Indonesia, DKI Jakarta. In *JPI: Jurnal Pemuda Indonesia* (Vol. 2, Number 1). Pelayanan Kepemudaan.

Fadillah, A. Y., & Indahwati, N. (2026). Analisis Kemampuan Motorik Ditinjau dari Perbedaan Pola Bermain pada Anak Usia 12-15 tahun. *SPRINTER: Jurnal Ilmu Olahraga*, *7*(1), 155–164. https://doi.org/10.46838/spr.v7i1.1024

Ferawati. (2025). *DIGITAL PEDAGOGICAL NEEDS IN PHYSICAL EDUCATION: MAPPING TEACHER AND STUDENT PERSPECTIVES ON MULTIMEDIA GYMNASTICS LEARNING*. *1*. https://doi.org/10.21009/ishel.v1i1.56721

Granić, A. (2022). Educational Technology Adoption: A systematic review. *Education and Information Technologies*, *27*(7), 9725–9744. https://doi.org/10.1007/s10639-022-10951-7

Hamdi, M., Sawitri, E., Daru, T. P., Tricahyadinata, I., & Rorimpandey, B. (2022). Strategi sukses belajar era digital di perguruan tinggi. In *Jurnal Ekonomi, Keuangan dan Manajemen* (Vol. 18, Number 4).

Harsanti, H. R., Sudibjo, N., Riady, S., & Yu, P. (2025). Exploring Indonesian teachers' intention to use artificial intelligence in schools: the impact of digital leadership, digital readiness, and perceived usefulness. *Cogent Social Sciences*, *11*(1). https://doi.org/10.1080/23311886.2025.2593596

Hernani, M. R. A., Nepangue, J. U., Canillas, J. A., Elumbaring, J. B., Dagoc, P. P., Janito, C. R., Calixtro, M. A., Kumar, R., Imperial, R. T., Rosario, M. A. B., Reyes, M. D. L., Mangubat, C. M. T., Saniel, J. P. S., Tenebroso, D. A. C., & Tagare, R. L. (2025). Examining the Efficacy of Pedometer Use in Enhancing Fitness Level: The Case of Tertiary Students in a State University. *Universal Journal of Public Health*, *13*(4), 877–886. https://doi.org/10.13189/ujph.2025.130411

Indah, N., Anwar, A., & Syafruddin, M. A. (2026). TINGKAT PEMAHAMAN MAHASISWA TENTANG PENTINGNYA AKTIVITAS FISIK DAN HUBUNGANNYA DENGAN GAYA HIDUP SEDENTER. In *Jurnal Ilmiah SPIRIT* (Vol. 26, Number 1).

Indarto, P., Nasuka, N., Furqon Hidayatullah, M., Sulaiman, S., & Setyawati, H. (2025). Journal of Physical Education and Sports Physical Education Curriculum in Elementary Schools: Efforts for Sustainable Movement Education. *JPES*, *14*(1). http://journal.unnes.ac.id/sju/index.php/jpes

Lee, J. B., Sung, B. J., Ko, B. G., Cho, E. H., & Seo, T. B. (2023). A comparative study on the reliability and validity of body composition results by impedance method measurement device. *Journal of Exercise Rehabilitation*, *19*(5), 299–308. https://doi.org/10.12965/jer.2346404.202

Yogesh, M., Trivedi, N., Makwana, N., Krishna, P. H. P. P., & D, K. (2024). Prevalence of normal weight obesity and its cardiometabolic implications among government doctors in Gujarat, India: a cross-sectional study. *Clinical Diabetes and Endocrinology*, *10*(1). https://doi.org/10.1186/s40842-024-00189-2

Mudarra-García, N., Pérez-Mudarra, M., Ortuño-Soriano, I., Badía-Iborra, R., Vicente-Galán, M. J., Zaragoza-García, I., Roque-Rojas, F., & García-Sánchez, F. J. (2025). Impact of Exams on Diet, Physical Activity, and Body Composition in University Students. *Nutrients* , *17*(11). https://doi.org/10.3390/nu17111929

Nurafiati, S., & Angriawan, T. (2025). Transformasi model berdiferensiasi berbasis teknologi pada pembelajaran penjas di perguruan tinggi Makassar. *Jurnal Pendidikan Jasmani Indonesia*, *21*(1), 21–30. https://doi.org/10.21831/jpji.v21i1.78645

OECD Digital Education Outlook 2026. (2026). OECD Publishing. https://doi.org/10.1787/062a7394-en

Parker, H., Hunt, E. T., Brazendale, K., Klinggraeff, L. von, Jones, A., Burkart, S., Dugger, R., Armstrong, B., Beets, M. W., & Weaver, R. G. (2022). Accuracy and Precision of Opportunistic Measures of Body Composition from the Tanita DC-430U. *Childhood Obesity*, *17*, 211–235. https://doi.org/10.1089/chi.2022.0084

Nur Raiyawan, F., (2021). *ANALISIS KONDISI CORE STRENGHT MAHASISWA PENDIDIKAN GEOGRAFI UNESA SELAMA PEMBELAJARAN DARING PENJASBUG DIMASA PANDEMI*. https://ejournal.unesa.ac.id/index.php/jurnal-pendidikan-jasmani/issue/archive469https://ejournal.unesa.ac.id/index.php/jurnal-pendidikan-jasmani

Risnawati, Y., Hendra, M., Lestari, N. C., Apriliyani, E. S., Arsyad, M., & Efrina, G. (2025). Learning Transformation in the Digital Era: A Literature Review on Innovations in

Teaching Methods and Media. *The Future of Education Journal*, *4*, Page. https://journal.tofedu.or.id/index.php/journal/index

Rufi'i, R., Sudana D., I. N., Degeng, M. D. K., Sari, M. N., Setyawan, H., Sari, D. A., Hanifah, I. N., Matsuri, M., Arien, W., & Pavlovic, R. (2026). Evaluation of Physical Education Learning for Students with Special Needs Based on Digital Technology. *International Journal of Human Movement and Sports Sciences*, *14*(2), 526–538. https://doi.org/10.13189/saj.2026.140224

Runisah, D., Sina, I., Anggaraeni Putri, K., Jasmani, P., & Bina Bangsa, U. (2026). *Pemanfaatan Media Digital Dalam Pembelajaran Pendidikan Jasmani, Olahraga dan Kesehatan (PJOK)*. https://doi.org/10.59818/jpi.v6i1.2573

Sahbana Ridha. (2025). *9% Overall Similarity Filtered from the Report Exclusions 7 Excluded Sources Integrity Flags 0 Integrity Flags for Review*. www.researchsquare.com

Samouda, H., & Langlet, J. (2022). Body fat assessment in youth with overweight or obesity by an automated bioelectrical impedance analysis device, in comparison with the dual-energy x-ray absorptiometry: a cross sectional study. *BMC Endocrine Disorders*, *22*(1). https://doi.org/10.1186/s12902-022-01111-6

Setiawan, Y., & Lontoh, S. O. (2023). *TINGKAT AKTIVITAS FISIK DAN STATUS GIZI PADA MAHASISWA KEDOKTERAN UNIVERSITAS TARUMANAGARA*.

Toselli, S., Campa, F., Matias, C. N., de Alencar Silva, B. S., dos Santos, V. R., Maietta Latessa, P., & Gobbo, L. A. (2021). Predictive equation for assessing appendicular lean soft tissue mass using bioelectric impedance analysis in older adults: Effect of body fat distribution. *Experimental Gerontology*, *150*. https://doi.org/10.1016/j.exger.2021.111393

Utomo, S., Kiani Cakrawati, D., Rachman Sadewa, Y., & Woro Mulaksito Mulyadi, R. (2025). Hubungan aktivitas fisik dan kualitas tidur dengan kebugaran jasmani peserta didik sekolah menengah atas. *Jurnal Pendidikan Jasmani Indonesia*, *21*(2), 150–162. https://doi.org/10.21831/jpji.v21i2.86871

Zhong, Q., Jiang, J., Bai, W., Yin, Z., Liao, Z., & Zhong, X. (2025). Application of digital-intelligent technologies in physical education: a systematic review. In *Frontiers in Public Health* (Vol. 13). Frontiers Media SA. https://doi.org/10.3389/fpubh.2025.1626603