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Effectiveness of a sports energy e-module in hybrid learning for physical education students

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Abstract

This study aims to examine the effectiveness of electronic modules on sports nutrition in sports nutrition courses. This study employed a quasi-experimental one-group pre-test–post-test design involving 60 physical education students enrolled in sports nutrition courses. The research instruments consisted of comprehension tests, affective assessments, and skills tests related to calculating energy and nutritional requirements. Data were analyzed using paired-sample t-tests. The results showed significant improvements in cognitive scores, $t(59) = 16.16$, $p < 0.05$, $d = 2.281$. There was an increase in students' affective $t(59) = 7.70$, $p < 0.05$, $d = 0.97$. There was an increase in students' skills $t(59) = 28.99$, $p < 0.05$, $d = 5.692$. These findings indicate that the use of the sports nutrition e-module was associated with improvements in students' cognitive, affective, and skills scores during hybrid learning. The sports nutrition e-module may serve as a digital learning resource that supports competency development in sports nutrition learning contexts.

Keywords: Sports nutrition, sports energy, hybrid learning, e-module, learning effectiveness.

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INTRODUCTION

The growing emphasis on nutrition education in schools has increased the need for physical education teachers with adequate competencies in sports nutrition and energy management. Schools have long recognized the importance of nutrition programs in supporting student

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health and well-being (Ennis, 2011; Hills et al., 2015). However, providing food alone is insufficient, as attention must also be given to the nutritional content of meals and to whether nutrient intake aligns with students' energy requirements (Abadi et al., 2025; Mauer et al., 2022; Ryan et al., 2022). Likewise, students' physical activity levels need to be considered to ensure that energy expenditure is balanced with nutritional intake (Baena-Morales et al., 2021). In this context, physical education teachers are expected not only to understand sports nutrition concepts but also to calculate students' energy requirements and recommend appropriate physical activities (Hasan et al., 2023; Martín-Rodríguez & Madrigal-Cerezo, 2025). Consequently, prospective physical education teachers need competencies in sports nutrition and in the calculation of caloric requirements (Patton-Lopez et al., 2018) to support physical education learning and provide recommendations on physical activity in both school and non-school settings (Pratama et al., 2026).

The competencies required of prospective physical education teachers extend beyond general knowledge of nutrition. Teachers are increasingly expected to understand how nutritional intake, energy expenditure, and physical activity interact within educational settings. Previous studies have highlighted the need for competencies related to measuring energy requirements and nutritional intake among physical education teachers (Son et al., 2025). Although sports nutrition is commonly included in teacher education curricula, opportunities to develop practical skills in calculating energy requirements and nutritional intake remain limited (Lee & Sung, 2025). Therefore, teacher education programs need to equip prospective physical education teachers with competencies related to healthy lifestyle promotion, nutritional awareness, and the practical ability to calculate students' energy and nutritional needs (Beketova et al., 2022; Wibowo & Indrayana, 2019). These competencies are important for supporting physical education programs and providing evidence-based recommendations regarding nutrition and physical activity among school students (Jodczyk et al., 2021; Merma-Molina et al., 2023).

Alongside these educational needs, the use of digital learning resources has become increasingly common in higher education. The development of e-modules has expanded in parallel with the adoption of various instructional approaches, including hybrid learning models (Cahniyo et al., 2024). In sports nutrition courses, hybrid learning offers opportunities to combine face-to-face instruction with digital resources to support students' engagement with course materials and lectures (Jonvik et al., 2022; Rossi et al., 2017). The sports energy e-module used in this context incorporates multimedia-based concept visualizations that help students understand the relationship between energy metabolism, physical activity, and sports nutrition requirements more concretely (Ariffudin & Latifah, 2022; Lopes et al., 2018). In addition, the e-module contains interactive exercises and structured case studies that provide opportunities for students to practice calculating sports energy requirements. Features such as instructions, feedback, and tiered evaluations are included to support learning activities during hybrid lectures (Delen et al., 2014; Janson et al., 2020; Lestari & Atun, 2021; McCardle et al., 2019).

Previous research has demonstrated the relevance of digital teaching materials for supporting learning in sports nutrition. Mashuri et al. (2022), involving 52 students enrolled in sports nutrition courses, reported that the transition from conventional learning to hybrid learning increased the need for digital teaching materials to support competency development. Students perceived that digital learning resources facilitated learning and supported their ability to calculate nutritional requirements and provide recommendations for training and diet. Similarly, previous studies have highlighted the relevance of digital teaching materials in supporting sports nutrition learning (Mashuri et al., 2024). Despite these developments, empirical evidence regarding the effectiveness of sports energy e-modules in improving learning outcomes remains limited. The integration of sports energy e-modules into hybrid sports nutrition learning is considered relevant to support student learning activities; however, their effectiveness requires empirical testing. In this study, effectiveness is operationally defined as

improvements in students' pre-test and post-test scores in cognitive understanding, affective response, and practical skills related to calculating energy and macronutrient requirements. Although digital learning materials for sports nutrition have been developed and validated by experts, empirical evidence regarding their effectiveness in improving cognitive, affective, and skills outcomes among physical education students remains limited. Therefore, this study aims to examine the effectiveness of a sports energy e-module in improving cognitive, affective, and skills competencies among physical education students in hybrid sports nutrition learning.

METHOD

This study used a quantitative approach and employed a quasi-experimental, one-group pre-test–post-test design. The study examined the effectiveness of a sports energy e-module without comparing it with other teaching materials. Consequently, the design has limitations in internal validity because learning experiences occurring outside the intervention could introduce history effects. At the same time, students' prior exposure to the assessment during the pre-test could generate testing effects that influence readiness and performance during the post-test. Therefore, the observed changes in learning outcomes should be interpreted with caution, as the causal relationship between the intervention and learning outcomes may not be entirely free of bias.

The participants were 60 students from the Physical Education program, Faculty of Sports and Health, Universitas Pendidikan Ganesha, who were enrolled in a sports nutrition course. All students participating in the sports nutrition course were included in the study. The research instrument consisted of a sports energy competency test developed for sports nutrition learning, which included cognitive, affective, and skills assessments. Content validity was evaluated using Aiken's V index. Five validators were selected based on their expertise, professional experience, and academic qualifications, consisting of an instructional design expert, a nutrition science expert, an instructional media expert, a sports nutrition practitioner, and a communication linguist. The validation results produced

Aiken's V values of 0.67 for the instructional design expert, 0.61 for the nutrition science expert, 0.71 for the instructional media expert, 0.82 for the sports nutrition practitioner, and 0.81 for the communication linguist. The overall Aiken's V coefficient was 0.72, indicating acceptable content validity. Instrument reliability demonstrated adequate internal consistency, with a Cronbach's alpha coefficient of 0.74.

The cognitive domain was measured using a multiple-choice test that assessed students' understanding of sports nutrition concepts and sports energy requirements. The affective domain was measured using a healthy lifestyle questionnaire designed to assess students' affective responses toward balanced nutrition, physical activity, and sports nutrition learning. The skills domain was assessed through students' ability to calculate energy requirements and macronutrient intake based on sports nutrition cases. All instruments were administered during both the pre-test and post-test phases.

The intervention was conducted during the sports energy unit of the sports nutrition course. At the beginning of the learning process, students completed a pre-test consisting of a cognitive test, an affective questionnaire, and a skills test related to energy and macronutrient calculations. Learning activities were implemented using a hybrid learning format that combined face-to-face and online sessions. During the intervention, the sports energy e-module served as the primary learning resource and was integrated into lectures, guided discussions, project-based assignments, independent calculation exercises, and student presentations. Students used the e-module to study sports energy concepts, complete structured calculation tasks, analyze case-based nutrition problems, and present the results of energy and macronutrient requirement calculations. After completion of the sports energy learning unit, students completed a post-test using the same instruments administered during the pre-test to assess changes in cognitive, affective, and skills outcomes.

Student competency data were summarized according to the assessment domains and analyzed using descriptive and inferential statistics. Prior to hypothesis testing, the assumption of normality was examined using the Shapiro–Wilk test. The results showed that all pre-test and post-test scores in the cognitive, affective, and skills domains were normally distributed, as indicated by p-values exceeding 0.05. Specifically, the cognitive domain obtained significance values of 0.057 (pre-test) and 0.054 (post-test), the affective domain obtained significance values of 0.236 (pre-test) and 0.162 (post-test), and the skills domain obtained significance values of 0.682 (pre-test) and 0.710 (post-test). These findings indicated that the data met the assumptions required for parametric analysis. Therefore, a paired-sample t-test was used to examine differences between pre-test and post-test scores. In addition, Cohen's d effect size analysis was conducted to determine the magnitude of score changes between measurements and to strengthen the interpretation of the statistical findings.

Table 1. Shapiro-Wilk Normality Test

	Statistic	df	Sig.	Note
Pre-kog	.942	60	.057	normal
Post-kog	.936	60	.054	normal
Pre-afec	.974	60	.236	normal
Post-afec	.971	60	.162	normal
Pre-ski	.961	60	.682	normal
Post-ski	.979	60	.710	normal

RESULT

Cognitive test results showed that before receiving the sports energy e-module in sports nutrition lectures, students scored 57,92 (SD=11.87). After receiving the sports nutrition e-module in sports nutrition classes.

Table 1. Description of Students' Pre-test and Post-test Cognitive Data

N=60	Student Understanding		
	Pre-test	Post-test	Different
Average	57.92	80.00	22.08
SD	11.87	6.83	10.59
Varians	140.93	46.61	112.11
Maks	75.00	95.00	45.00
Min	35.00	60.00	5.00

Table 1 presents the descriptive statistics of students' cognitive scores before and after the intervention. The mean cognitive score increased from 57.92 to 80.00. The affective test results showed that before receiving the sports energy e-module in sports nutrition lectures, students scored 36.55 (SD=3.23).

Table 2. Description of Data on Affective Towards Use and Intake of Sports Nutrition

N=60	Student Affective		
	Pre-test	Post-test	Different
Average	36.55	40.07	3.52
SD	3.23	3.98	3.54
Varians	10.46	15.83	12.53
Maks	43.00	51.00	12.00
Min	30.00	32.00	-5.00

Table 2 presents the descriptive statistics of students' affective scores before and after the intervention. The mean affective score increased from 36.55 to 40.07.

Table 3. Description of Data on Skills in Calculating Macro Nutrient Requirements and Intake

N=60	Student Skills		
	Pre-test	Post-test	Different
Average	35.50	85.17	49.67
SD	7.90	9.48	13.27
Varians	62.46	89.80	176.16
Maks	50.00	100.00	80.00
Min	20.00	70.00	20.00

Table 3 presents the descriptive statistics of students' skills scores before and after the intervention. The mean skills score increased from 35.50 to 85.17. The results of the test of skills in calculating energy requirements and macro nutrient intake showed that before receiving the

sports energy e-module in sports nutrition lectures, students scored 35.50 (SD=7.9) for skills.

Table 4. Test of Difference in Mean Understanding of Students

N	t-tabel	Mean		Cohen's d	SD	t-score	ρ-value
		Pre	Post				
60	2.00	57.92	80	2.281	10.59	16.16	0.00

The paired-sample t-test results are presented in Tables 4–6. For the cognitive domain, the analysis showed t(59) = 16.16, p < .001, Cohen's d = 2.281. For the affective domain, the analysis showed t(59) = 7.70, p < .001, Cohen's d = 0.97. For the skills domain, the analysis showed t(59) = 28.99, p < .001, Cohen's d = 5.692.

Table 5. Test of Mean Difference in Student Affective

N	t-table	Mean		Cohen's d	SD	t-score	ρ-value
		Pre	Post				
60	2,00	36,55	40,07	0,97	3,54	7,7	0.00

Based on the calculation results, it can be reported that the t(59) = 7.7, ρ < 0.05, Cohen's d = 0.97. It can be concluded that there was a significant increase in students' affective toward sports nutrition material in sports nutrition courses after the provision of e-modules on sports nutrition. Next, an analysis of the mean difference in student skill scores was conducted.

Table 6. Test of Mean Difference in Student Skills

N	t-table	Mean		Cohen's d	SD	t-score	ρ-value
		Pre	Post				
60	2,00	35,5	85,17	5,692	13,27	28,99	0,00

Based on the calculation results, it can be reported that the t(59) = 28,99, ρ < 0.05, Cohen's d = 5,692. It can be concluded that there was a significant increase in students' skills in sports nutrition material in sports nutrition courses after being given e-modules on sports nutrition.

DISCUSSION

The findings of this study indicate that the use of the sports energy e-module during hybrid Sports Nutrition learning was associated with improvements in students' cognitive, affective, and skills scores. Improvements were observed in students' understanding of sports nutrition

concepts, affective responses toward sports nutrition learning, and skills in calculating energy and macronutrient requirements. These findings suggest that the sports energy e-module functioned as a learning resource that supported competency development within the context of hybrid learning. The observed improvements in cognitive scores, affective responses, and practical skills indicate that students were able to engage with sports nutrition content more effectively through learning activities supported by the e-module.

The improvement observed in the cognitive domain suggests that students gained a better understanding of concepts related to energy requirements, physical activity, and nutritional planning. Digital learning materials have been widely recognized as tools that support conceptual understanding by presenting information in a structured manner and facilitating engagement with learning content (Brown et al., 2022; Henriques et al., 2023; Zhou et al., 2026). Previous studies have also reported that multimedia-supported learning resources can improve students' comprehension of scientific concepts when integrated into learning activities (Lin et al., 2017). In the present study, the sports energy e-module provided organized learning materials that enabled students to examine the relationship between energy metabolism, physical activity, and nutritional requirements in sports settings. The observed increase in cognitive scores indicates that students were better able to understand the concepts presented throughout the learning process, particularly concepts related to energy balance, nutritional planning, and the role of nutrition in supporting physical activity and sports performance.

The improvement in the skills domain reflects students' increased ability to perform calculations related to energy requirements and macronutrient intake. The skills domain showed the largest increase among the measured variables, suggesting that structured learning activities and repeated practice contributed to students' ability to apply sports nutrition concepts in practical situations. This finding is consistent with previous research indicating that interactive digital learning materials can support

procedural learning through structured exercises and repeated practice (Henriques et al., 2023). Throughout the learning process, students completed a series of calculation activities involving nutritional status assessment, basal metabolic rate estimation, and specific dynamic action calculations, which are important components in determining individual energy requirements (Phytanza et al., 2022; Mocha-Bonilla et al., 2018; Rossi et al., 2017). Students also learned to estimate daily activity expenditure and sports-related energy expenditure as part of sports nutrition planning (Ratna et al., 2025; Saputro et al., 2025). In addition, learning activities included growth-related energy calculations and dietary planning recommendations, enabling students to apply sports nutrition concepts in practical situations (Yasa et al., 2025; Shidik et al., 2025). Students were able to calculate the energy requirements of individuals involved in sports activities as well as those with more general physical activity patterns. They were also able to formulate macronutrient recommendations based on the conditions presented in learning cases. Similar findings have been reported by Zhou et al. (2026), who found that digital learning resources can facilitate the acquisition of applied skills when learners are actively involved in guided practice activities.

Improvements were also observed in the affective domain. The increase in affective scores suggests that students demonstrated more positive responses toward sports nutrition learning after participating in learning activities supported by the e-module. This finding may indicate greater interest, attention, and involvement in sports nutrition content during the learning process. The integration of learning materials, practical exercises, and case-based activities contributed to students' willingness to engage more actively with the subject matter. However, the interpretation of this result should remain within the scope of the affective indicators measured in this study. Therefore, the findings should not be extended to claims regarding long-term lifestyle changes, sustained behavioral modification, or health outcomes because these variables were not directly assessed.

The present findings are in line with previous studies suggesting that electronic teaching materials can support competency development in higher education settings (Holisoh et al., 2025). Within hybrid learning environments, digital teaching materials play an important role in providing learning resources that support instructional activities and student participation (Widodo et al., 2024). In this study, the sports energy e-module was integrated into lectures, discussions, guided exercises, and calculation-based learning activities. Learning activities supported by the e-module included discussions, guided exercises, and calculation tasks related to energy requirements and macronutrient intake. During these activities, students applied sports nutrition concepts to simulated cases and examples used in learning exercises. The use of structured discussions during online learning is consistent with previous findings emphasizing the role of interaction and discussion in supporting conceptual understanding in higher education learning environments (Kusuma et al., 2024; Pratiwi & Nadhiroh, 2024). In this context, discussions provided opportunities for students to examine sports nutrition concepts and apply calculation procedures introduced in the e-module. Although discussion activities formed part of the learning process, variables such as self-regulated learning, self-directed learning, learning autonomy, and engagement were not measured directly. Consequently, these aspects should be regarded as possible instructional contexts rather than empirical findings of the study.

The relationship between conceptual understanding and skill development may also be explained through competency development perspectives, which emphasize that knowledge acquisition can support the development of practical skills through repeated application and practice (Deci & Ryan, 2008; Fujinuma & Wendling, 2015; Salman et al., 2020; Smeby & Heggen, 2014; Veldman et al., 2019). In the current study, students first learned theoretical concepts related to sports energy and nutrition before applying these concepts through calculation exercises and case-based activities. This learning sequence explains why improvements were observed in both cognitive and skills scores following the intervention.

As students developed a stronger understanding of sports nutrition concepts, they were better able to apply those concepts when calculating energy requirements and macronutrient needs. Nevertheless, because the study employed a one-group pre-test–post-test design without a control group, the observed improvements should be interpreted as score changes that occurred after the intervention rather than as definitive causal effects attributable solely to the e-module.

As a potential implication, improvements in students' competencies in energy and macronutrient calculations may contribute to nutrition literacy initiatives in educational settings. These competencies may be relevant to school-based nutrition education programs and broader discussions regarding balanced nutrition and nutritional awareness. In addition, knowledge related to sports nutrition may support future educational efforts aimed at promoting understanding of energy balance, nutritional planning, and healthy dietary practices among students. Previous studies have highlighted the importance of integrating nutrition education into educational environments as part of broader health promotion efforts (Hayes et al., 2018). Similar findings were reported by Chaudhary et al. (2020), who emphasized the role of schools in promoting nutritional awareness and healthy eating behaviors. Improving nutritional literacy among prospective physical education teachers is particularly important because schools play a strategic role in shaping healthy behaviors among children and adolescents. In this context, students who master sports nutrition concepts may contribute to disseminating practical knowledge related to energy balance, meal planning, and nutritional awareness within educational settings.

Several limitations should be considered when interpreting the findings of this study. First, the research focused on short-term changes in cognitive, affective, and skills scores and did not evaluate long-term retention of knowledge or skills. Although improvements in competency scores were observed during the intervention, the extent to which these competencies are maintained over time remains unclear. Second, the application of sports

nutrition competencies in professional practice, community engagement, or educational settings was not examined directly. Consequently, the effectiveness of these competencies in supporting nutrition education, parental awareness, school-based health promotion, or community health initiatives remains unknown. Third, broader contextual factors such as socioeconomic conditions, access to nutritious foods, cultural dietary habits, and environmental support systems were not included in the analysis. Future research should incorporate these factors and employ longitudinal or field-based designs to provide stronger evidence regarding the role of sports nutrition education in supporting nutrition literacy and health promotion initiatives (Moschonis et al., 2021; Truman et al., 2020).

CONCLUSION

The use of the sports energy e-module in sports nutrition courses during hybrid learning was associated with improvements in students' cognitive, affective, and skills scores based on pre-test and post-test results. The findings indicate better understanding of sports energy concepts, more positive affective responses toward sports nutrition learning, and improved skills in calculating energy and macronutrient requirements. These results should be interpreted as score improvements observed during the intervention rather than definitive causal evidence, as the study employed a one-group pre-test–post-test design without a control group and focused only on short-term learning outcomes. Nevertheless, the sports energy e-module may serve as a useful digital learning resource in hybrid sports nutrition courses. Future studies are encouraged to use more rigorous research designs, larger samples, and longitudinal approaches to strengthen evidence regarding their contribution to learning outcomes in sports nutrition education.

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REFERENCES

Abadi, M. N. P., Basrowi, R. W., Gunawan, W. Ben, Arasy, M. P., Nurjihan, F., Sundjaya, T., Pratiwi, D., Hardinsyah, H., Astuti Taslim, N., & Nurkolis, F. (2025). Unraveling Future Trends in Free School Lunch and Nutrition: Global Insights for Indonesia from Bibliometric Approach and Critical Review. *Nutrients 2025, Vol. 17, Page 2777*, *17*(17), 2777. https://doi.org/10.3390/NU17172777

Ariffudin, I., & Latifah, L. (2022). Flipbook trends and their influence on the development of guidance and counseling teaching media in higher education: Bibliometric analysis. *Journal of Advanced Guidance and Counseling*, *3*(2), 136–148. https://doi.org/10.21580/JAGC.0.0.0.13522

Baena-Morales, S., Jerez-Mayorga, D., Delgado-Floody, P., & Martínez-Martínez, J. (2021). Sustainable Development Goals and Physical Education. A Proposal for Practice-Based Models. *International Journal of Environmental Research and Public Health 2021, Vol. 18, Page 2129*, *18*(4), 2129. https://doi.org/10.3390/IJERPH18042129

Beketova, G. V., Savinova, K. B., Mozgova, G. P., & Beketova, N. V. (2022). A healthy lifestyle is the base of maintaining the health of schoolchildren. *CHILD`S HEALTH*, *16*(8), 509–514. https://doi.org/10.22141/2224-0551.16.8.2021.248705

Brown, A., Lawrence, J., Basson, M., & Redmond, P. (2022). A conceptual framework to enhance student online learning and engagement in higher education. *Higher Education Research & Development*, *41*(2), 284–299. https://doi.org/10.1080/07294360.2020.1860912

Cahniyo, A., Kuswanto, W., & Pratiwi, D. D. (2024). Development of physical education e-modules for students of the Islamic early childhood education program: utilisation of the FlipHTML5 application. *Edu Sportivo: Indonesian Journal of Physical Education*, *5*(3), 306–316. https://doi.org/10.25299/ESIJOPE.2024.VOL5(3).16371

Chaudhary, A., Sudzina, F., & Mikkelsen, B. E. (2020). Promoting Healthy Eating among Young People—A Review of the Evidence of the Impact of School-Based Interventions. *Nutrients*, *12*(9), 2894. https://doi.org/10.3390/NU12092894

Clark, R. C., & Mayer, R. E. (2024). Designing for e-learning. *Trends and Issues in Instructional Design and Technology: Fifth Edition*, 524–540. https://doi.org/10.4324/9781003502302-43

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology*

/ *Psychologie Canadienne*, *49*(3), 182–185. https://doi.org/10.1037/a0012801

Delen, E., Liew, J., & Willson, V. (2014). Effects of interactivity and instructional scaffolding on learning: Self-regulation in online video-based environments. *Computers & Education*, *78*, 312–320. https://doi.org/10.1016/J.COMPEDU.2014.06.018

Ennis, C. D. (2011). Physical education curriculum priorities: Evidence for education and skillfulness. *Quest*, *63*(1), 5–18. https://doi.org/10.1080/00336297.2011.10483659

Fujinuma, R., & Wendling, L. A. (2015). Repeating Knowledge Application Practice to Improve Student Performance in a Large, Introductory Science Course. *International Journal of Science Education*, *37*(17), 2906–2922. https://doi.org/10.1080/09500693.2015.1114191

Hasan, B., Kardi, I. S., & Nurhidayah, D. (2023). Student Daily Calorie Intake and Physical Activity Levels during the COVID-19 Pandemic. *Jurnal Pendidikan Jasmani Dan Olahraga*, *8*(1), 103–110. https://doi.org/10.17509/JPJO.V8I1.53879

Hayes, D., Contento, I. R., & Weekly, C. (2018). Position of the Academy of Nutrition and Dietetics, Society for Nutrition Education and Behavior, and School Nutrition Association: Comprehensive Nutrition Programs and Services in Schools. *Journal of Nutrition Education and Behavior*, *50*(5), 433-439.e1. https://doi.org/10.1016/J.JNEB.2018.03.001

Henriques, S., Damásio, M. J., & Rosa, P. J. (2023). School-based interventions using media technologies to promote health behavior change and active learning about nutrition: A systematic literature review and meta-analysis. *Active Learning for Digital Transformation in Healthcare Education, Training and Research*, 113–145. https://doi.org/10.1016/B978-0-443-15248-1.00014-X

Hills, A. P., Dengel, D. R., & Lubans, D. R. (2015). Supporting Public Health Priorities: Recommendations for Physical Education and Physical Activity Promotion in Schools. *Progress in Cardiovascular Diseases*, *57*(4), 368–374. https://doi.org/10.1016/J.PCAD.2014.09.010

Holisoh, A., Pahamzah, J., & Hidayat, S. (2025). Literature Review on the Use of Electronic Modules in Independent Learning in Higher Education. *Journal of General Education and Humanities*, *4*(1), 153–164. https://doi.org/10.58421/gehu.v4i1.368

Janson, A., Söllner, M., & Leimeister, J. M. (2020). Ladders for Learning: Is Scaffolding the Key to Teaching Problem-Solving in Technology-Mediated Learning Contexts? *Academy of Management Learning & Education*, *19*(4), 439–468. https://doi.org/10.5465/AMLE.2018.0078

Jodczyk, A. M., Gruba, G., Sikora, Z., Kasiak, P. S., Gębarowska, J., Adamczyk, N., Mamcarz, A., & Śliż, D. (2021). PaLS study: How has the COVID-19 pandemic influenced physical activity and nutrition? observations a year after the outbreak of the pandemic. *International*

Journal of Environmental Research and Public Health, *18*(18), 9632. https://doi.org/10.3390/IJERPH18189632

Jonvik, K. L., King, M., Rollo, I., Stellingwerff, T., & Pitsiladis, Y. (2022). New Opportunities to Advance the Field of Sports Nutrition. *Frontiers in Sports and Active Living*, *4*, 852230. https://doi.org/10.3389/FSPOR.2022.852230

Kusuma, D. W. Y., Yuwono, C., Qoriah, A., Supriyono, & Wiyanto, A. (2024). Psychological and nutritional analysis of athletes for Semarang sports week championship 2023. *Jurnal SPORTIF : Jurnal Penelitian Pembelajaran*, *10*(2), 288–304. https://doi.org/10.29407/js_unpgri.v10i2.23338

Lee, K. L., & Sung, J. Y. (2025). Impact of sports nutrition education on awareness and knowledge among physical education majors and workers. *Journal of the International Society of Sports Nutrition*, *22*(1). https://doi.org/10.1080/15502783.2025.2498485

Lestari, A., & Atun, S. (2021). The Effectiveness of E-Module on Buffer Solutions to Improve Students' Higher-Order Thinking Skills and Self-Regulated Learning. *JTK (Jurnal Tadris Kimiya)*, *6*(2), 254–266. https://doi.org/10.15575/JTK.V6I2.13772

Lin, M. H., Chen, H. C., & Liu, K. S. (2017). A Study of the Effects of Digital Learning on Learning Motivation and Learning Outcome. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(7), 3553–3564. https://doi.org/10.12973/EURASIA.2017.00744A

Lopes, C., Torres, D., Oliveira, A., Severo, M., Guiomar, S., Alarcão, V., Ramos, E., Rodrigues, S., Vilela, S., Oliveira, L., Mota, J., Teixeira, P. J., Nicola, P. J., Soares, S., Andersen, L. F., & IAN-AF Consortium. (2018). National Food, Nutrition, and Physical Activity Survey of the Portuguese General Population (2015-2016): Protocol for Design and Development. *JMIR Research Protocols*, *7*(2), e42. https://doi.org/10.2196/resprot.8990

Martín-Rodríguez, A., & Madrigal-Cerezo, R. (2025). Technology-Enhanced Pedagogy in Physical Education: Bridging Engagement, Learning, and Lifelong Activity. *Education Sciences 2025, Vol. 15, Page 409*, *15*(4), 409. https://doi.org/10.3390/EDUCSCI15040409

Mashuri, H., Gunarto, P., Adi, I. P. P., Mappaompo, M. A., & Purwanto, D. (2022). Bahan Ajar Digital Ilmu Gizi Olahraga dalam Hybrid Learning: Sebuah Studi Pendahuluan. *Gelanggang Pendidikan Jasmani Indonesia*, *6*(1), 41–50. https://doi.org/10.17977/um040v6i1p41-50

Mashuri, H., Gunarto, P., & I Putu Panca Adi. (2024). Blueprint Elektronik Modul Energi Olahraga Matakuliah Ilmu Gizi Olahraga dalam Hybrid Learning. *Jurnal Ilmu Keolahragaan*, *23*(1), 21–28. https://doi.org/10.24114/jik.v23i1.57386

Mauer, S., Torheim, L. E., & Terragni, L. (2022). Children's Participation in Free School Meals: A Qualitative Study among Pupils, Parents, and

Teachers. *Nutrients 2022, Vol. 14, Page 1282*, *14*(6), 1282. https://doi.org/10.3390/NU14061282

McCardle, L., Young, B. W., & Baker, J. (2019). Self-regulated learning and expertise development in sport: current status, challenges, and future opportunities. *International Review of Sport and Exercise Psychology*, *12*(1), 112–138. https://doi.org/10.1080/1750984X.2017.1381141

Merma-Molina, G., Urrea-Solano, M., González-Víllora, S., & Baena-Morales, S. (2023). Future physical education teachers' perceptions of sustainability. *Teaching and Teacher Education*, *132*, 104254. https://doi.org/10.1016/J.TATE.2023.104254

Mocha-Bonilla, J. A., Sanchez Guerrero, J., Jimenez, L. A., Pilamunga Poveda, M., Barona-Onate, R., & Sanchez Guerrero, A. G. (2018). Analysis of the Body Composition Index and Basal Metabolic Rate Through the Mobile Application eHealth-UTA. *5th International Conference on E-Democracy and E-Government, ICEDEG 2018*, 386–391. https://doi.org/10.1109/ICEDEG.2018.8372326

Moschonis, G., Magriplis, E., & Zampelas, A. (2021). Novel Nutrition Education Approaches for Health Promotion: From Investigating Problems to Finding Solutions. *Nutrients*, *13*(12), 4423. https://doi.org/10.3390/NU13124423

Patton-Lopez, M. M., Manore, M. M., Branscum, A., Meng, Y., & Wong, S. S. (2018). Changes in Sport Nutrition Knowledge, Attitudes/Beliefs and Behaviors Following a Two-Year Sport Nutrition Education and Life-Skills Intervention among High School Soccer Players. *Nutrients*, *10*(11), 1636. https://doi.org/10.3390/NU10111636

Pethusamy, K., Gupta, A., & Yadav, R. (2022). Basal Metabolic Rate (BMR). *Encyclopedia of Animal Cognition and Behavior*, 620–621. https://link.springer.com/referenceworkentry/10.1007/978-3-319-55065-7_1429

Phytanza, D. T. P., Burhaein, E., Lourenço, C. C. V., Budiman, Yusuf, J., Kinasih, A., Gandasari, M. F., & Taroreh, B. S. (2022). Nutritional Status of Children Aged 6-17 Years: The Condition during the COVID-19 Pandemic Reviewing Weight Indexed by Height. *Universal Journal of Public Health*, *10*(2), 159–167. https://doi.org/10.13189/UJPH.2022.100202

Pratama, F., Mashuri, H., Adnyana, I. K. S., & Adnyana, F. P. H. M. I. K. S. (2026). Analyze of body mass index (BMI) and macronutrition needs for student age 11-13. *Citius : Jurnal Pendidikan Jasmani, Olahraga, Dan Kesehatan*, *6*(1), 25–34. https://doi.org/10.32665/CITIUS.V6I1.5954

Pratiwi, R., & Nadhiroh, S. R. (2024). Enhancement of Sports Nutrition Knowledge and Energy Intake After Sports Nutrition Education for Combat Athletes. *Media Gizi Indonesia*, *19*(2), 188–197. https://doi.org/10.20473/mgi.v19i2.188-197

Ratna, K., Mashuri, H., & Semarayasa, I. K. (2025). Analysis of the nutritional status and needs of 11-year-old primary school students. *Sriwijaya Journal of Sport*, *4*(2), 210–219. https://doi.org/10.55379/SJS.V4I2.25

Rossi, F. E., Landreth, A., Beam, S., Jones, T., Norton, L., & Cholewa, J. M. (2017). The Effects of a Sports Nutrition Education Intervention on Nutritional Status, Sport Nutrition Knowledge, Body Composition, and Performance during Off Season Training in NCAA Division I Baseball Players. *Journal of Sports Science & Medicine*, *16*(1), 60. https://pmc.ncbi.nlm.nih.gov/articles/PMC5358033/

Ryan, D., Holmes, M., & Ensaff, H. (2022). Adolescents' dietary behaviour: The interplay between home and school food environments. *Appetite*, *175*, 106056. https://doi.org/10.1016/J.APPET.2022.106056

Salman, M., Ganie, S. A., & Saleem, I. (2020). The concept of competence: a thematic review and discussion. *European Journal of Training and Development*, *44*(6–7), 717–742. https://doi.org/10.1108/EJTD-10-2019-0171

Saputro, P. D., Mashuri, H., & Dartini, N. P. D. S. (2025). Analisis Status Gizi dan Kebutuhan Kalori Peserta Didik Usia 7-10 Tahun. *JURRIPEN: Jurnal Riset Rumpun Ilmu Pendidikan*, *4*(2), 528–536. https://doi.org/10.55606/JURRIPEN.V4I2.5773

Shidik, M. Q., Mashuri, H., & Dartini, N. P. D. S. (2025). Analisis Status Gizi dan Kebutuhan Energi Peserta Didik Usia 13-15 Tahun. *Jurnal Cerdas Sifa Pendidikan*, *14*(1), 26–39. https://doi.org/10.22437/CSP.V14I1.45159

Smeby, J. C., & Heggen, K. (2014). Coherence and the development of professional knowledge and skills. *Journal of Education and Work*, *27*(1), 71–91. https://doi.org/10.1080/13639080.2012.718749

Son, J. J., Lee, M. J., Lee, D. R., Park, S. S., & Sung, J. Y. (2025). A study on the awareness and education status of sports nutrition in college students majoring in physical education: based on the career selection. *Physical Activity and Nutrition*, *29*(1), 25. https://doi.org/10.20463/PAN.2025.0004

Truman, E., Bischoff, M., & Elliott, C. (2020). Which literacy for health promotion: health, food, nutrition or media? *Health Promotion International*, *35*(2), 432–444. https://doi.org/10.1093/HEAPRO/DAZ007

Veldman, S. L. C., Santos, R., Jones, R. A., Sousa-sá, E., & Okely, A. D. (2019). Associations between gross motor skills and cognitive development in toddlers. *Early Human Development*, *132*(December 2018), 39–44. https://doi.org/10.1016/j.earlhumdev.2019.04.005

Wibowo, Y. G., & Indrayana, B. (2019). Sport: A Review of Healthy Lifestyle in the World. *Indonesian Journal of Sport Science and Coaching*, *1*(1), 30–34. https://doi.org/10.22437/ijssc.v1i1.6580

Widodo, A., Irianto, D. P., Graha, A. S., Yudanto, Y., Hardianto, D., Sutapa, P., Karakauki, M., Ali, S. K. S., Kristiyanto, A., & Pratama, K. W. (2024). The Personalized System of E-Modul Instructions in Physical Education Online Learning. *Retos: Nuevas Tendencias En Educación Física, Deporte y Recreación*, *56*, 319–327. https://doi.org/10.47197/retos.v56.103515

Yasa, I. K. E. P., Mashuri, H., & Adnyana, I. K. S. (2025). Analysis of nutritional status and needs of 10th-grade high school students. *Sriwijaya Journal of Sport*, *4*(2), 124–135. https://doi.org/10.55379/SJS.V4I2.29

Zhou, Q., Jiang, J., Yin, Z., & Fan, R. (2026). Effect of Digital Health Interventions on College Students' Lifestyle Behaviors: Systematic Review. *Journal of Medical Internet Research*, *28*(1), e82192. https://doi.org/10.2196/82192