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Digital-Based E-module in Tennis Learning for Undergraduate Students in Sports Education

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Abstract

Although many studies have examined the use of e-modules for physical education at school and university levels, very few explore the development of digital-based e-modules in tennis learning. This research aims to develop a digital-based e-module in tennis learning for undergraduate sports education students. It was conducted using the Research and Development (R&D) design by adopting the Plomp model. The model consists of preliminary research, prototyping, and assessment phases. This research invited 12 experts, consisting of 4 material experts, 4 language experts, and 4 media experts. The experts were professors and lecturers with profound expertise in their respective fields. This research also involved 35 sports education undergraduate students taking tennis courses, consisted of males (n=25) and females (n=10). The instrument was a Likert scale questionnaire. Validity testing was measured using Aiken's V validity coefficient. The reliability was calculated using Intraclass Correlation Coefficients (ICC), while product practicality was analyzed using percentages. The results show that the average product validity before and after revision was 0.790 (medium) and 0.904 (high), while the average reliability was 0.754 (high). In terms of practicality, the average was 89.71, which means the product is very practical. In conclusion, digital-based e-modules in tennis learning can be used for undergraduate sports education students. This research is expected to facilitate undergraduate sports education students, lecturers, and tennis practitioners to overcome limitations in teaching tennis. Future research is needed to test the product's effectiveness by conducting an experimental design and comparing it with other groups.

Keywords: *content validity, instruments, technology, higher education*

Introduction

Tennis is one of the practical courses for undergraduate students in sports education. This sport is intermittent, characterized by repeated high intensity (e.g., acceleration, deceleration, change of direction, and stroke). It requires physical fitness components like speed, agility, muscle strength, and cardiovascular fitness (Fernandez-Fernandez, Sanz, Sarabia, & Moya, 2016).

The development of tennis learning in universities is universal. In general, the learning course focuses on developing students' understanding of the basic knowledge of tennis, such as characteristics, basic skills, and basic hitting methods. Because this knowledge is fundamental, teaching staffs need to increase students' interest and enthusiasm to learn it (Wang, 2021). One of the strategies is utilizing technology in teaching because various applications of technological intelligence have changed traditional ways of teaching (Elbamby, Perfecto, Bennis, & Doppler, 2018). Although technology has been gradually integrated into the learning course, it does not mean that the roles of the teaching staff have been replaced (Freeman et al., 2016). Instead, their tasks in teaching activities have shifted from traditional to designing materials, creating innovations, and helping and motivating students (Berg & Vance, 2016), as exemplified in e-modules (Komikesari et al., 2020).

An e-module is an information and communication technology-based module. Such an interactive module offers convenience in giving display, images, audio, video, animation,

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and feedback through formative tests and quizzes (Voithofer, 2005). This type of feedback will make it easier for students to study independently according to their respective abilities (Alnedral, Ihsan, Mario, Aldani, & Sari, 2023). Additionally, the ever-evolving and changing education system (from face-to-face learning to online platforms) has made it an important aspect for a long time (Blaine, 2019).

Previous studies have examined the role of technology in achieving successful learning for physical education at school (Handayani, Myori, Yulifri, Komaini, & Mario, 2023) and university levels (Alnedral et al., 2023; Born, Nguyen, Grambow, Meffert, & Vogt, 2021; Wang, 2021). For example, Born et al. (2018) integrated tennis teaching videos into a classroom. This integration has been shown to be effective in improving forehand and backhand techniques in college students. Wang (2021) also reported that the Android-based online tennis teaching information platform was also proven to be effective for use with college students. Similar results were also provided by Chen, Yang, & Xie (2022), who designed a multimedia teaching system for tennis using 5G-enabled internet technology. In Indonesia, the Android-based TennBasTech application was designed and developed by Mulya et al. (2021) to teach tennis to athletes aged 10 to 11 years.

In this regard, the application of digital-based e-modules has also been investigated by previous studies (Alnedral et al., 2023). However, these studies focus on learning Tarung Derajat martial arts at the basic level. The results show that e-modules can be used by sports students to achieve effective self-defense learning. Then, Handayani et al. (2023) also developed Android-based gymnastics learning media, which has proven effective in improving handstand skills in junior high school students. To our knowledge, very few studies have examined the development of digital-based e-modules in tennis instruction for undergraduate sports education students.

Therefore, this research aims to develop a digital-based e-module in tennis learning for undergraduate students in sports education. This research is very important because the use of multimedia technology can speed up the reform of tennis teaching, changing it from traditional teaching to a more interactive way. Hence, the teaching theory, form, and quality can be effectively improved (Li, He, Liu, & Yu, 2017). This research is aimed at overcoming limitations in tennis learning, both for undergraduate sports education students, lecturers and tennis practitioners.

Methods

Study design

This research was conducted with the R&D design. It adopted the design from Plomp and Nieveen (2013). The research would develop and evaluate a digital-based e-module in tennis learning for undergraduate sports education students.

Participant

A total of 12 experts participated in this research, consisting of 4 material experts, 4 language experts, and 4 media experts. The experts were professors and lecturers who had expertise in their respective fields. Then, this research also involved 35 sports education undergraduate students from the Faculty of Sports Science, Universitas Negeri Padang, Indonesia. Participants were students taking tennis courses, consisting of males (n=25) and females (n=10) (Table 1). This research was carried out with the approval of the Institute for Research and Community Service at Universitas Negeri Padang, Indonesia (contract number: 803/UN35.13/LT/2021).

Table 1. Characteristics of participants

Characteristics	Sex	
	Male (n=25)	Female (n=10)
Age	21.27 ± 1.03	20.94 ± 0.96
Weight	65.33 ± 4.51	62.35 ± 3.52
Height	169.52 ± 2.36	165.28 ± 2.03
BMI	22.73 ± 1.17	22.82 ± 1.12

Procedures and instruments

This research went through several procedures: preliminary research, prototyping, and assessment phases (Plomp & Nieveen, 2013). Preliminary research is the initial stage, which consists of student analysis, learning planning analysis, learning objectives, learning mechanisms, curriculum analysis, and material analysis. The prototyping stage is the product design stage in the form of a digital-based e-module in tennis learning. In this phase, the research has started making an e-module cover, foreword and table of contents, instructions for using the e-module, learning materials (initial introduction to learning tennis, forehand learning, backhand learning, service learning, and volleyball learning), learning videos, quizzes, assignments, evaluations, and reference lists (Figures 1.a and 1.b).

The prototyping phase began with making a cover for the e-module. The cover was designed to include one of the national tennis players from the province of West Sumatra, Indonesia. Meanwhile, images and interactive media were also presented in a more interesting way and were adapted to the material studied at each meeting. The material was adapted to the basic materials in learning tennis for undergraduate sports education students (learning implementation plan). Then, the technical explanation was presented as best as possible and refers to the ease with which students can learn theoretically and practically, both in groups and independently.

Following that, the e-module has an instruction menu where users can learn how to use the media, both online and offline. Each material was available in pdf format. Additionally, learning videos that explained how to perform tennis techniques were available in the video menu. The assignment menu and quizzes were done in a Google form containing instructions and uploaded by students in a format containing the student identification number.

The first material in the e-module was "an initial introduction to learning tennis". This activity aims to maintain focus on the ball, practice target accuracy, and develop coordination (eyes, hands, and feet). The second material was "forehand learning". Forehand learning in this e-module shows how the ball is hit with a forehand method, using either the right or left

hand (can be done horizontally or with a spin). This material can be done according to the alternatives given by the lecturer. Following that, the third material was "backhand learning". The execution of the backhand consists of a ready position, backswing, forward swing, and follow-up movement. It was the next material was "service learning". The execution of the serve presented consists of ready position, swing, contact with the ball, follow-up movement, and grip. Then, the fifth material was "volley learning". The main aim of volleying is to speed up the return of the ball to the opponent's playing area by cutting off the speed of the incoming ball.

Then, the products that have been designed were assessed by experts, who independently reviewed and evaluated the relevance of the content. Meanwhile, the practicality of the product involved undergraduate sports education students who have used digital-based e-modules in learning tennis for one semester (± 4 months). This instrument is presented in Table 2.

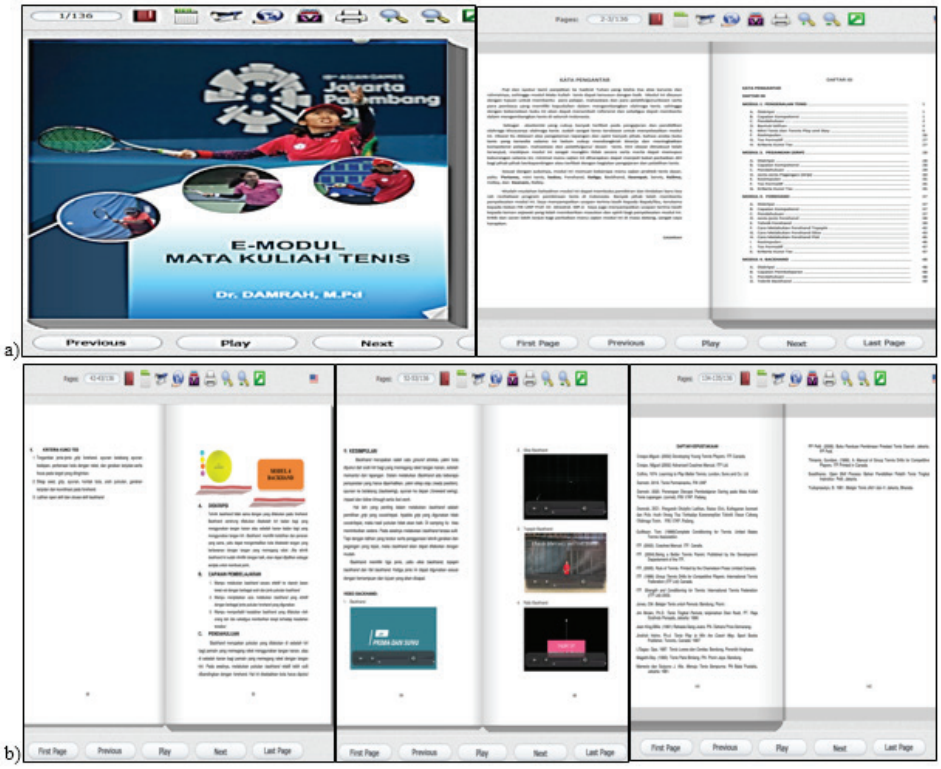

FIGURE 1. a) Cover, foreword, and table of contents; b) Learning materials, learning videos, and reference list

Table 2. Research instruments

Aspect	Assessment items
Material experts (n=4)	The suitability of the title on the e-module.
	Introduction in e-module.
	Suitability of the material with the learning objectives (learning plan)
	E-modules are arranged systematically.
	The presentation of material in the e-module is arranged in a complete and easy-to-understand manner.
	E-modules are equipped with clear examples.
	The material presented in the e-module is adjusted to the needs of students (analytical skills).
	E-module contains supporting theories.
	E-module contains theories that do not conflict with social and moral values.
	The explanation in the e-module shows that its implementation is efficient in terms of time and is effective in increasing student learning motivation.
Language experts (n=4)	The language used in the e-module is very communicative.
	The message conveyed in the e-module is easy for readers to understand.
	The language used in the e-module is simple and precise in its use.
	The use of capital letters and lowercase letters in the e-module is correct.
	The terms and words used in the e-module are easy to understand.
	Sentences and paragraphs in the e-module meet the Indonesian language writing conventions.

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Table 2. Research instruments

Aspect	Assessment items
Media experts (n=4)	The appearance of the e-module is very interesting.
	The media components are appropriate.
	The size and color of the letters in the e-module are balanced.
	The typeface used in the e-module is easy to read.
Product practicability (n=35)	The appearance of text, tables, and images on the e-module is correct.
	The display for presenting material and videos on the e-module is correct.
	Suitability of the material with the learning objectives (learning plan).
	The presentation of the material is very practical and easy to understand.
	The language used is easy to understand.
	E-module is very interesting and increases learning motivation.
	E-module can improve the ability to learn tennis.
	E-modules can be used anytime and anywhere (online and offline).

Note- The assessment was scored with the following points: very valid/practical (score 5), valid/practical (score 4), quite valid/practical (score 3), less valid/practical (score 2), and not valid/practical (score 1).

Statistical analyses

Inter-rater validity testing in this research was performed using Aiken's V validity coefficient (Aiken, 1985), while ICC (Cho, 1981) was used to measure the reliability. Then, the product practicality testing was analyzed with percentages (achievement score/maximum score*100%) (Firdaus et al., 2023). The classification for this assessment is presented in Table 3.

Aiken's: $V = \frac{\sum s}{n(c-1)}$

"V" is the rater agreement index, "s" is the score assigned by each rater minus the lowest score in the category, "n" is the number of raters, and "c" is the number of categories selected by the rater.

ICC: $ICC = \frac{\sigma_s^2}{\sigma_s^2 + \sigma_o^2 + \sigma_e^2}$

"σ2" is the measure of variation, "s" is the subject, "o" is the observer, and "e" is random error.

Table 3. Classification for validity, reliability, and practicality

Validity		Reliability		Practicality	
Index V	Classification	ICC	Classification	Score	Classification
V < 0.4	Low	> 0.80	Very high	81-100%	Very practical
0.4 ≤ V ≤ 0.8	Medium	0.61-0.80	High	61-80%	Practical
V > 0.8	High	0.41-0.60	Medium	41-60%	Practical enough
		< 0.41	Low	21-40%	Less practical
				0-20%	Not practical

Results

Product validity

This section provides information about the product's validity after being tested in several stages. Validity testing at stage 1, for example, obtained an average validity of 0.790 (medium), as shown in Table 4. Expert comments at the revision stage are presented in Table 5, and Figure 1 shows the final form of the resulting product. Then, validity testing after the product was revised in stage 2 generated an average validity of 0.904 (high) (Table 6). The differences in product validity tests before and after revision are presented in Figure 2.

Table 4. Testing the validity of stage one (before revision)

Items	Material experts (n=4)				s1	s2	s3	s4	∑s	n(c-1)	V	Classification
	1	2	3	4								
1	4	4	5	4	3	3	4	3	13	16	0.813	High
2	5	4	4	4	4	3	3	3	13	16	0.813	High
3	5	4	5	5	4	3	4	4	15	16	0.938	High
4	3	3	4	3	2	2	3	2	9	16	0.563	Medium
5	4	4	4	4	3	3	3	3	12	16	0.750	Medium
6	4	4	4	4	3	3	3	3	12	16	0.750	Medium

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Table 4. Testing the validity of stage one (before revision)

Items	Material experts (n=4)				s1	s2	s3	s4	∑s	n(c-1)	V	Classification
	1	2	3	4								
7	4	4	4	3	3	3	3	2	11	16	0.688	Medium
8	4	4	4	3	3	3	3	2	11	16	0.688	Medium
9	4	4	4	5	3	3	3	4	13	16	0.813	High
10	5	5	5	4	4	4	4	3	15	16	0.938	High
					ẋ						0.775	Medium
Items	Language experts (n=4)				s1	s2	s3	s4	∑s	n(c-1)	V	Classification
	1	2	3	4								
1	4	5	4	4	3	4	3	3	13	16	0.813	High
2	4	4	4	4	3	3	3	3	12	16	0.750	Medium
3	3	4	3	3	2	3	2	2	9	16	0.563	Medium
4	5	5	5	4	4	4	4	3	15	16	0.938	High
5	5	5	5	5	4	4	4	4	16	16	1.000	High
6	4	4	4	4	3	3	3	3	12	16	0.750	Medium
					ẋ						0.802	High
Items	Media experts (n=4)				s1	s2	s3	s4	∑s	n(c-1)	V	Classification
	1	2	3	4								
1	3	3	3	3	2	2	2	2	8	16	0.500	Medium
2	5	5	5	5	4	4	4	4	16	16	1.000	High
3	5	5	4	4	4	4	3	3	14	16	0.875	High
4	5	5	5	4	4	4	4	3	15	16	0.938	High
5	5	5	5	5	4	4	4	4	16	16	1.000	High
6	3	3	2	3	2	2	1	2	7	16	0.438	Medium
					ẋ						0.792	Medium
					ẋ (overall)						0.790	Medium

Note- "S" is the score assigned to each rater and subtracted from the lowest score in the category, while "V" is the agreement index of the rater.

Table 5. Expert comments

Experts (N = 12)	**Comment**
Material (n=4)	E-modules need to be arranged systematically. The e-module material needs to be completed. Examples of the implementation of the e-module materials need to be completed. E-modules should be tailored to the needs of students (online and offline). The e-module material needs to be supplemented with supporting theories.
Language (n=4)	The message conveyed in the e-module should be improved to make it easier for readers to understand. The language used in the e-module should be simplified. Sentences and paragraphs in the e-module must comply with the writing rules.
Media (n=4)	The appearance of the e-module as a whole is more refined. Views for presenting material are more refined.

Table 6. Testing the validity of stage two (after revision)

Items	Material experts (n=4)				s1	s2	s3	s4	∑s	n(c-1)	V	Classification
	1	2	3	4								
1	4	4	5	4	3	3	4	3	13	16	0.813	High
2	5	4	4	4	4	3	3	3	13	16	0.813	High
3	5	4	5	5	4	3	4	4	15	16	0.938	High
4	4	4	4	4	3	3	3	3	12	16	0.750	High
5	5	5	5	5	4	4	4	4	16	16	1.000	High

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Table 6. Testing the validity of stage two (after revision)

Items	Material experts (n=4)				s1	s2	s3	s4	∑s	n(c-1)	V	Classification
	1	2	3	4								
6	5	5	5	5	4	4	4	4	16	16	1.000	High
7	5	5	5	4	4	4	4	3	15	16	0.938	High
8	5	5	5	5	4	4	4	4	16	16	1.000	High
9	4	4	4	5	3	3	3	4	13	16	0.813	High
10	5	5	5	4	4	4	4	3	15	16	0.938	High
					ẋ						0.900	High
Items	Language experts (n=4)				s1	s2	s3	s4	∑s	n(c-1)	V	Classification
	1	2	3	4								
1	4	5	4	4	3	4	3	3	13	16	0.813	High
2	5	5	5	5	4	4	4	4	16	16	1.000	High
3	4	5	4	4	3	4	3	3	13	16	0.813	High
4	5	5	5	4	4	4	4	3	15	16	0.938	High
5	5	5	5	5	4	4	4	4	16	16	1.000	High
6	5	5	5	4	4	4	4	3	15	16	0.938	High
					ẋ						0.917	High
Items	Media experts (n=4)				s1	s2	s3	s4	∑s	n(c-1)	V	Classification
	1	2	3	4								
1	4	4	4	5	3	3	3	4	13	16	0.813	High
2	5	5	5	5	4	4	4	4	16	16	1.000	High
3	5	5	4	4	4	4	3	3	14	16	0.875	High
4	5	5	5	4	4	4	4	3	15	16	0.938	High
5	5	5	5	5	4	4	4	4	16	16	1.000	High
6	4	4	4	4	3	3	3	3	12	16	0.750	High
					ẋ						0.896	High
					ẋ (overall)						0.904	High

Note- "S" is the score assigned to each rater and subtracted from the lowest score in the category, while "V" is the agreement index of the rater.

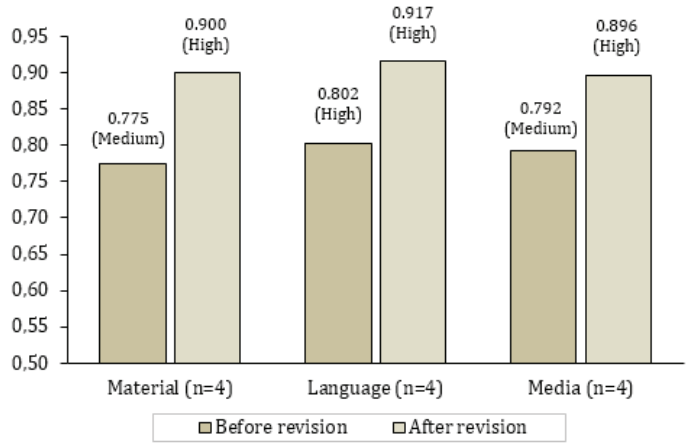

FIGURE 2. Differences and classification of validity levels before and after revision

Product reliability

As presented in Table 7, the average level of reliability is 0.754 (high). This means that raters in this research have no difference in assessing the product ($P<0.05$).

Product practicality

This research also measures how practical the product is. Table 8 indicates the average student response to the product (e-module), by 89.71 (very practical). The student responses to each item are presented in Figure 3.

Discussion

The results of this product development show a difference in the average validity between before and after revisions, by

Table 7. Reliability testing

Material experts (n=4)	ICC	Value	F test with true values		
			df1	df2	P*
Single measures	0.406	3.732	9	27	0.004
Average measures	0.732*	3.732	9	27	0.004
Language experts (n=4)	ICC	Value	F test with true values		
			df1	df2	P*
Single measures	0.444	4.200	5	15	0.014
Average measures	0.762*	4.200	5	15	0.014
Media experts (n=4)	ICC	Value	F test with true values		
			df1	df2	P*
Single measures	0.451	4.286	5	15	0.013
Average measures	0.767*	4.286	5	15	0.013
ẋ (ICC)			0.754		

Note- Average measures are the ICC values of each expert. There is no difference in assessment among experts (P<0.05).

Table 8. Product practicality

Items	Answer score	N	Percentage	Classification
1	150	35	85.71	Very practical
2	163	35	93.14	Very practical
3	169	35	96.57	Very practical
4	140	35	80.00	Practical
5	150	35	85.71	Very practical
6	170	35	97.14	Very practical
	ẋ		89.71	Very practical

Note- Percentage is obtained from the achievement score/maximum score*100%. The maximum item score is 175, while the minimum item score is 35.

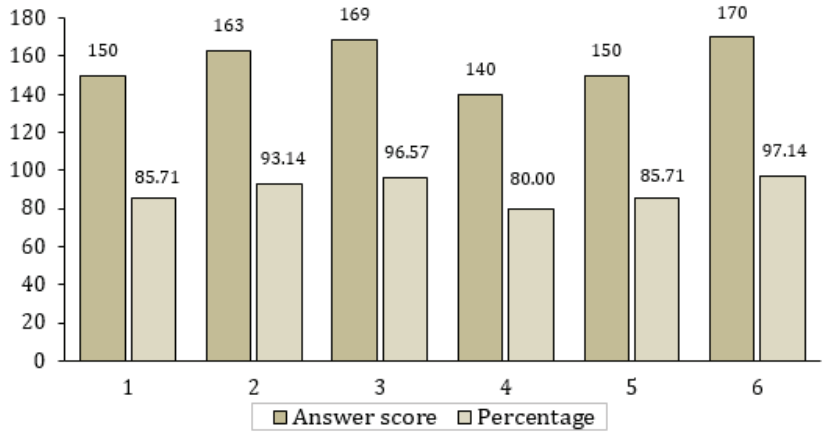

FIGURE 3. Answer scores and the percentage of each item

0.790 (medium) and 0.904 (high). Meanwhile, the average reliability was 0.754 (high). Then, the average product practicality was 89.71 (very practical). These scores imply that digital-based e-modules in tennis learning can be used for undergraduate sports education students. This e-module can be used online or offline, so it can be accessed anytime and anywhere (during and outside the course schedule) (Lu'mu, 2017). Using the e-module is expected to increase knowledge, collaboration with others, and learning experience (McQuiggan, McQuiggan, Sabourin, & Kosturko, 2015).

The learning media developed in this research has gone through the validity and reliability testing stages. These stages are fundamental and must be fulfilled (Rifki et al., 2022). According to some scholars, the minimum requirement for all developed instruments is to have content validity (Almanasreh, Moles, & Chen, 2019). Content validity is different from other types of validity. It describes what is required of the content of the instrument and is not related to the scores obtained on the constructs (Sireci & Faulkner-Bond, 2014). It is carried out by involving two or more assessors who are independently tasked with reviewing and evaluating the relevance of the content represented in the instrument (Wynd, Schmidt, & Schaefer, 2003).

On the other hand, the determination of reliability shows no differences in assessments (Robertson, Burnett, & Cochrane, 2013). As mentioned earlier, the ICC value was used to analyze the level of agreement between several raters (Koo & Li, 2016). These results were consulted to make improvements until an agreement was reached to produce a product in the form of a digital-based e-module in tennis learning for undergraduate sports education students.

The use of technology in learning is highly recommended to improve optimal learning outcomes. Previous studies reported that online instructional formats such as e-modules and computer-based simulation programs can improve knowledge (Sitzmann, Kraiger, Stewart, & Wisher, 2006) and promote opportunities for flexible learning at low cost (Dankbaar & Jong, 2014). Likewise, online teaching has better learning effects on tennis skills, knowledge of tennis theory, and academic performance compared with traditional teaching methods (Wang, 2021). Specific performance of the role of technology can be seen in designing learning activities, promoting the learning process, helping to solve students' psychological problems, and caring for the overall development of all students (Dascal et al., 2017). In this process, lecturers must try to raise student interest. The lecturers need to gain knowledge from students, while monitoring and correcting mistakes made by students in the learning process (Chen et al., 2022).

The development stage to product practicality has informed us about several limitations in this research. There were 12 experts involved according to their expertise, so a wider size of experts was needed to validate the developed product. In addition, product practicality involved 35 undergraduate students in sports education, so a wider sample size was needed. Then, this research suggests that the first and the second stages should be carried out with an experimental design to prove the effectiveness of the developed product. The stages need to be compared (for example, one of the basic tennis techniques contained in the e-module to prove its improvement).

Conclusion

In conclusion, this research promotes the development of a product in the form of a digital-based e-module in tennis learning for undergraduate sports education students. This product development seems convincing since the average values of product validity before and after revision increase from 0.790 (medium) to 0.904 (high). In addition, other indicators also show strong support, such as the average reliability of 0.754 (high) and the average product practicality of 89.71 (very practical). Thus, digital-based e-modules can be used to teach tennis among undergraduate students in sports education. This research is hoped to facilitate undergraduate sports education students, lecturers, and tennis practitioners to overcome limitations in teaching tennis. Nevertheless, future research is still needed to test the effectiveness of the product. Experimental and comparison designs are two suggested options that subsequent researchers can use.

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Conflict of interest:
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