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Original Article

Designing an Electronic Cognitive Test Considering The Stages of Technical Performance and Legal Points of Crawl Swimming

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Abstract

The study dealt with constructing an electronic cognitive test for the swimming course for female students of the Faculty of Physical Education, Sadat City University. The researcher used the descriptive approach. The research community included first-year female students at the Faculty of Physical Education - University of Sadat City who were enrolled in the academic year (2023-2024), numbering 811 students. The research sample amounted to (211) students. The most important results were that the designed electronic test is one of the modern technologies in swimming. In addition, the number of test phrases amounted to (56) phrases, (3) phrases to measure the history axis, (48) phrases to measure the skill performance axis, and (5) phrases to measure the law axis.

Keywords: *Electronic cognitive test, Cognitive, Crawl Swimming*

Introduction

application of integrated scientific learning, a fundamental change in the process of presenting the material is required so that learning can give students a positive impression. (Rahayu, 2015)

Students should be more active in finding information, and teachers should be more creative and innovative in presenting the material. The material teachers present should be interesting and can arouse students' activity. In some schools, teachers still present learning materials in traditional ways and through media, such as teacher-centered methods. (Dewi, 2018)

Measurement matters. Although reason and imagination also advance knowledge, only measurement makes it possible to observe patterns and to experiment to put one’s guesses about what is and is not true to the test. From a practical standpoint, intentionally changing something is dramatically easier when one can quantify with precision how much or how little of it there is. (Duckworth, 2015)

Educational testing has attempted, with considerable success, to measure the degree to which students achieve certain educational objectives. Efficient technology has been developed to assess what facts and applications the student knows achievement tests usually call upon the student to demonstrate his knowledge of terms and facts, to appropriately apply these elements of information, and to show his comprehension of organizing schemes. (Kubiszyn, 2024)

Teachers spend much time talking with students lecturing, giving directions, and asking and answering questions. To ensure understanding and application of knowledge, teachers commonly engaged students in question-and-answer sessions. Questions can prompt responses ranging from simple recall of information to abstract processes of applying, synthesizing, and evaluating information. (Zepeda, 2009)

Bloom and his colleagues developed a continuum for categorizing questions and responses. Bloom's taxonomy includes the following elements, arranged from lowest to highest order: Knowledge: recalling specific facts; Comprehension: describing in one's own words; Application: applying information to produce some result; Analysis: subdividing something to show how it is put together; Synthesis: creating a unique, original product; and Evaluation: making value decisions about issues. The first three levels of this system deal with lower-order thinking skills essential in laying the foundation for deeper understanding. The last three employ higher-order thinking skills. (Hopper, 2009)

Authors believes that electronic tests are an effective tool in improving the quality of education and evaluating performance in various fields, including teaching swimming. They improve performance evaluation as they help provide an accurate and rapid assessment of learning information and knowledge related to swimming. Coaches can also evaluate swimmers' performance more effectively, making identifying strengths and weaknesses easier. They also provide instant feedback as they allow learners to receive immediate feedback on their performance. This feedback helps swimmers understand the mistakes they make and work to improve them faster, which enhances the learning process. They also enhance interaction and participation by contributing to increasing learners' interaction with educational content. By using educational games and interactive tests, learners can feel motivated and actively participate in the learning process. They provide accessibility and diversity as electronic tests allow them to be accessed from anywhere and at any time. This contributes to providing a flexible learning environment that suits the different needs of learners, which enhances learning opportunities. They also provide data analysis and curriculum improvement as they help electronic tests collect and analyze data related to learners' performance, information, and knowledge. This data can be used to develop curricula and improve teaching methods, leading to better learning outcomes. The use of electronic tests is a powerful tool in swimming teaching, as it helps improve performance assessment, provides immediate feedback, and enhances interaction and participation. By taking advantage of this technology.

Based on the above and based on the fact that the use of electronic tests is in line with the Egyptian State Vision 2030, as one of the axes of that vision is "reaching the most effective technological and electronic formulas in presenting the targeted knowledge and scientific research and circulating them among students, teachers, and those who wish from the community", this is what the current research is trying to achieve, and by reviewing the reference studies and within the limits of the researcher's knowledge, the Authors found a scarcity of studies that addressed the design of an electronic cognitive test for crawl swimming, which prompted the Authors to conduct a study in which she designs an electronic cognitive test for female students of the Faculty of Physical Education, Sadat City University

Study Questions

Does the cognitive test measure the cognitive aspects of the technical performance phases and legal points of the crawl swimming?

Methods

the Authors used the descriptive approach because it is appropriate to the nature of the research.

Participants:

The sample of the research was randomly selected from the students of the first troupe of the Faculty of Physical Education - Sadat City University. The number of female students was 211 (25.39%) and enrolled in the academic year (2023 - 2024).

For the first pilot study, (11) students were chosen from the students of the fourth undergraduate year. The goal of this pilot stud was to test the validity of the cognitive test according to the factors (ease, difficulty, discrimination). In addition, to calculate the scientific coefficients to test cognitive achievement (honesty, persistence).

For the second pilot study, (211) students were selected from the students of the first undergraduate year. The purpose was to recognize wether the students understand the test and percept the vocabulary or there is difficulty. As well as to test the the clarity of the test procedures.

Procedures

Table 1 shows the stages of constructing the electronic cognitive achievement test. Where there were four steps to prepeare and build the online cognitive test of crawl swimming.

Table 1. stages of building the online cognitive test

Axis	includes			
Initial	Determining the objective	Analysis of the study content	The relative importance of the cognitive achievement test axes	
Second	Determining the type of questions	Formulating the vocabulary (questions) of the test	Preparing the test instructions	Test correction key
Third	The initial "first" version of the test	Test image after the expert opinion poll "The second image of the test"	Test vocabulary analysis (test of the validity of the test questions)	Calculating the scientific coefficients of the test (test experiment)
Fourth	The image of the test after calculating its scientific coefficients is “the third and final image of the test”		Determining the time to answer the test	
Fifth	Publish the cognitive test in its electronic form			

1. Determining the objective

The objective of the test was determined according to the objective and question of the research, which is to measure the level of cognitive achievement of the female students (the research sample) regarding the information and knowledge related to crawl swimming.

2. Analysis of the study content

The Authors analyzed (the description of the swimming course 2) for the first year, to identify the information and knowledge related to crawl swimming and to use it in designing the cognitive test. Based on that, the axes of the cognitive achievement test were reached as follows:

- History of swimming.
- Skill of crawl swimming.
- the international swimming law.

3. The relative importance of the cognitive achievement test axes

The cognitive achievement test axes were presented to (5) experts in the field of swimming at the faculties of physical education, Appendix (1), to express an opinion on the axes that are desired to be achieved and measured, as well as suggest what should be added to or deleted from them, and also determining the relative importance of these axes, Appendix (2) and Table (2) showing the opinions of the experts on the relative importance of the cognitive test axes.

Table (2) verify the relative importance of the opinions of the experts on the axes of the studied cognitive achievement test was limited to (5%: 85%).

Table (2) Average relative importance of the opinions of the experts on the cognitive test axes *N=5*

Axis		Relative Importance	
History			5%
Crawl Swimming	Body Position	10%	85%
	Leg Strikes	20%	
	Arm Movements	30%	
	Breathing	10%	
	Coordination	15%	
Law			10%
Total			**100%**

4. Determining the type of questions

The authors chose (true or false, multiple choice) questions, as the questions included (2) types as follows:

- **True or false questions (√ or X):** It is one of the most used types due to the ease of preparing its questions, which are chosen directly from the prescribed material or after making some minor changes to those questions.
- **Multiple choice questions**: The student is given a certain number of words or phrases related to a topic to choose the correct words or phrases.

The following table shows the distribution of cognitive achievement test questions based on the relative importance of the test axes.

Table (3) Average relative importance of the opinions of the experts on the cognitive test axes and the number of equivalent phrases in each axis (*N=5*)

Axis		Relative Importance		Number of questions	
History		5%		3 phrases	
Crawl Swimming	Body Position	10%	85%	6 phrases	51 phrases
	Leg Strikes	20%		12 phrases	
	Arm Movements	30%		18 phrases	
	Breathing	10%		6 phrases	
	Coordination	15%		9 phrases	
Law		10%		6 phrases	
Total		**100%**		**60 phrases**	

It is clear from Table (3) that the relative importance of the opinions of the experts was limited to (5%: 85%), and the number of phrases was limited to (3: 51) phrases.

5. Formulating the vocabulary (questions) of the test

The Authors formulated the vocabulary for the cognitive test questions after reviewing the research, studies, and scientific references No. (Hamed, 2020) (Al-Salmi, 2017). The number of test vocabulary reached (60) "question" vocabulary words, and the Authors formulated them in the form of questions

6. Preparing the test instructions

The Authors prepared the test instructions so that they would be simple and clear to the students, with an explanation of how to answer the questions. This form also included the students' data in terms of (name, grade, and academic year).

Table (4) Results of displaying the initial image of the cognitive achievement test to the experts (*N=5*)

Axis	Question Nr	Nr of times of agreement	Percentage of agreement	Question No	Nr of times of agreement	Percentage of agreement	Axis	Question No	Nr of times of agreement	Percentage of agreement
History	1)	4	80%	21)	4	80%	Crawl Swimming	41)	5	100%
	2)	4	80%	22)	5	100%		42)	4	80%
	3)	5	100%	23)	5	100%		43)	4	80%
Crawl Swimming	4)	5	100%	24)	5	100%		44)	4	80%
	5)	4	80%	25)	5	100%		45)	4	80%
	6)	5	100%	26)	5	100%		46)	4	80%
	7)	5	100%	27)	4	80%		47)	5	100%
	8)	5	100%	28)	4	80%		48)	4	80%
	9)	4	80%	29)	4	80%		49)	5	100%
	10)	4	80%	30)	5	100%		50)	4	80%
	11)	5	100%	31)	4	80%		51)	4	80%
	12)	4	80%	32)	4	80%		52)	5	100%
	13)	4	80%	33)	5	100%		53)	5	100%
	14)	5	100%	34)	5	100%		54)	4	80%
	15)	4	80%	35)	5	100%	the law	55)	4	80%
	16)	4	80%	36)	5	100%		56)	4	80%
	17)	4	80%	37)	4	80%		57)	5	100%
	18)	5	100%	38)	4	80%		58)	5	100%
	19)	5	100%	39)	4	80%		59)	5	100%
	20)	5	100%	40)	5	100%		60)	5	100%

7. Test correction key

The Authors corrected the test based on the correct answers to the test questions by calculating one point for each question of the test, and since the total number of questions is

(60) questions, the grand finale of the test equals (60) points, where one point is allocated for each correct answer, and zero for questions left without answers or wrong answers

8. The initial "first" version of the test

After the Authors reached the initial version of the cognitive test, which amounted to (60) questions, the Authors presented the test in its initial version.

Table (4) shows the number of times and percentages of agreement among the experts regarding the cognitive achievement test phrases. The Authors accepted an agreement percentage of 80% or more of the total opinions of the experts to accept the questions.

Table (5) Ease, difficulty, and discrimination coefficients for vocabulary (questions)Cognitive achievement test (*N=11*)

Axis	Question No	Ease Factor	Difficulty Factor	Discrimination Factor	Question No	Ease Factor	Difficulty Factor	Discrimination Factor	Axis	Question No	Ease Factor	Difficulty Factor	Discrimination Factor
Histor	1)	0.64	0.36	0.23	21)	0.45	0.55	0.25	Crawl Swimming	41)	0.36	0.64	0.23
	2)	0.64	0.36	0.23	22)	0.64	0.36	0.23		42)	0.55	0.45	0.25
	3)	0.64	0.36	0.23	23)	0.55	0.45	0.25		43)	0.45	0.55	0.25
Crawl Swimming	4)	0.55	0.45	0.25	24)	0.55	0.45	0.25		44)	0.55	0.45	0.25
	5)	0.55	0.45	0.25	25)	0.55	0.45	0.25		45)	0.64	0.36	0.23
	6)	0.64	0.36	0.23	26)	0.55	0.45	0.25		46)	0.64	0.36	0.23
	7)	0.55	0.45	0.25	27)	0.45	0.55	0.25		47)	0.55	0.45	0.25
	8)	0.45	0.55	0.25	28)	0.55	0.45	0.25		48)	0.55	0.45	0.25
	9)	0.55	0.45	0.25	29)	0.64	0.36	0.23		49)	0.45	0.55	0.25
	10)	0.64	0.36	0.23	30)	0.55	0.45	0.25		50)	0.64	0.36	0.23
	11)	0.64	0.36	0.23	31)	0.64	0.36	0.23		51)	0.45	0.55	0.25
	12)	0.45	0.55	0.25	32)	0.64	0.36	0.23		52)	0.45	0.55	0.25
	13)	0.64	0.36	0.23	33)	0.55	0.45	0.25		53)	0.73	0.27	0.20
	14)	0.55	0.45	0.25	34)	0.55	0.45	0.25		54)	0.64	0.36	0.23
	15)	0.45	0.55	0.25	35)	0.64	0.36	0.23	the law	55)	0.64	0.36	0.23
	16)	0.45	0.55	0.25	36)	0.55	0.45	0.25		56)	0.64	0.36	0.23
	17)	0.55	0.45	0.25	37)	0.55	0.45	0.25		57)	0.64	0.36	0.23
	18)	0.64	0.36	0.23	38)	0.55	0.45	0.25		58)	0.64	0.36	0.23
	19)	0.45	0.55	0.25	39)	0.64	0.36	0.23		59)	0.64	0.36	0.23
	20)	0.55	0.45	0.25	40)	0.64	0.36	0.23		60)	0.64	0.36	0.23

It is clear from Table (5) that the test is characterized by ease coefficients between (0.30 - 0.70) and difficulty coefficients (0.30 - 0.70) and that the distinction coefficient for the cognitive achievement test is more than (0.2), except for phrase No. (53).

10. Test vocabulary analysis (test of the validity of the test questions)

To identify the validity of the test questions, the Authors applied the cognitive test to the exploratory study sample of (11) female students to calculate the (ease, difficulty, and discrimination coefficients) for each of the test questions, and questions with ease and difficulty coefficients ranging between (0.3: 0.7) were accepted, and as for the discrimination coefficient, questions with a coefficient greater than (0.2) were accepted.

11. Calculating the scientific coefficients of the test (test experiment):

the Authors calculated the scientific coefficients of the cognitive achievement test.

Table (6) The correlation coefficient between the score of each phrase and the total of the axis to which it belongs, the correlation of the phrase with the total, and the correlation of the axes with the total of the cognitive achievement test (N=11)

Axis	Question No	Correlation Coefficient between			Question No	Correlation Coefficient between			Axis		Question No	Correlation Coefficient between		
		Phrase with axis	Phrase with total	Axis total with test total		Phrase with axis	Phrase with total	Axis total with test total				Phrase with axis	Phrase with total	Axis total with test total
Histor	21)	0.957*	0.752*	0.788*	41)	0.837*	0.826*	0.994*	Crawl Swimming	(٦١)	62)	0.691*	0.674*	0.994*
	22)	0.812*	0.646*		42)	0.968*	0.964*			(٦٣)	64)	0.912*	0.897*	
	23)	0.957*	0.752*		43)	0.792*	0.780*			(٦٥)	66)	0.837*	0.826*	
Crawl Swimming	24)	0.912*	0.897*	0.994*	44)	0.775*	0.765*			(٦٧)	68)	0.860*	0.860*	
	25)	0.775*	0.765*		45)	0.912*	0.897*			(٦٩)	70)	0.968*	0.964*	
	26)	0.968*	0.964*		46)	0.912*	0.897*			(٧١)	72)	0.968*	0.964*	
	27)	0.912*	0.897*		47)	0.700*	0.694*			(٧٣)	74)	0.792*	0.780*	
	28)	0.837*	0.826*		48)	0.775*	0.765*			(٧٥)	76)	0.912*	0.897*	
	29)	0.860*	0.860*		49)	0.968*	0.964*			(٧٧)	78)	0.768*	0.745*	
	30)	0.968*	0.964*		50)	0.792*	0.780*			(٧٩)	80)	0.968*	0.964*	
	31)	0.968*	0.964*		51)	0.968*	0.964*			(٨١)	82)	0.768*	0.745*	
	32)	0.837*	0.826*		52)	0.968*	0.964*			(٨٣)	84)	0.383	0.437	
	33)	0.968*	0.964*		53)	0.860*	0.860*			(٨٥)	86)	0.353	0.416	
	34)	0.860*	0.860*		54)	0.912*	0.897*			(٨٧)	88)	0.569	0.646*	
	35)	0.837*	0.826*		55)	0.968*	0.964*		the law	(٨٩)	90)	0.847*	0.714*	0.703*
	36)	0.691*	0.686*		56)	0.860*	0.860*			(٩١)	92)	0.922*	0.646*	
	37)	0.766*	0.758*		57)	0.912*	0.897*			(٩٣)	94)	0.772*	0.312	
	38)	0.968*	0.964*		58)	0.912*	0.897*			(٩٥)	96)	0.922*	0.646*	
	39)	0.837*	0.826*		59)	0.968*	0.964*			(٩٧)	98)	0.922*	0.646*	
	40)	0.792*	0.780*		60)	0.968*	0.964*			(٩٩	100)	0.847*	0.714*	

"R" at D.H.: (n) -2 = (9), and significance level (0.05) = 0.602

Test validity

The Authors calculated the validity of the test on a sample of (11) female students from the fourth year (first swimming major) by:

- Finding the correlation coefficient between the score of each phrase and the total of the axis to which it belongs.
- Finding the correlation coefficient between the score of each phrase and the total of the test.
- Finding the correlation coefficient between each axis and the total of the test.

The table (6) shows the correlation coefficients between the phrases and the total of the axis to which they belong, the correlation between the phrases and the total of the cognitive achievement test, and the correlation between the total of each axis and the total of the cognitive achievement test.

It is clear from Table (6) that there is a statistically significant correlation between the score of each phrase the total score of the axis represented by the phrase, and the total score of the test, except for phrases (52, 53, 54, 57), which indicates the validity of that phrases representation of the axis it represents and the studied test.

Test stability

The authors used the split-half method to calculate the stability of the cognitive achievement test, where the Authors used the validity scores and divided them into two halves.

- the first half (28 questions)
- the second half (28 questions**)**

The authors then calculated the correlation coefficient between the two halves of the test and thus obtained the stability of only half of the test. To obtain the overall stability coefficient of the cognitive achievement test, the "Spearman-Brown" equation was applied.

Table (7) Stability coefficients for the vocabulary (phrases) of the cognitive achievement test by split-half (N=11)

Test halves	Number of phrases	average	The correlation coefficient between the two halves of the test	Spearman-Brown correlation coefficient for the test as a whole
First half	28 phrases	20.91	0.974*	0.987*
Second half	28 phrases	20.36		
Total	56 phrases	41.27		

"R" at D.H.: (n) -2 = (9), and significance level (0.05) = 0.602

It is clear from Table (7) that the calculated value of "r" > the tabular value of "r", which indicates that the value of "r" is statistically significant. This indicates the existence of a

correlation between the first and second halves of the questions, and thus the stability of the cognitive achievement test.

12. The image of the test after calculating its scientific coefficients "the third and final image of the test"

It is clear from Table (8) that the number of cognitive achievement test phrases after conducting the scientific coefficients and the ease, difficulty, and discrimination coefficients was limited to (3: 48) phrases

Table (8) Number of phrases for the cognitive achievement test after conducting scientific coefficients and the ease, difficulty, and discrimination coefficients

Axis		Number of questions	
History			3 phrases
Crawl Swimming	Body Position	6 phrases	48 phrases
	Leg Strikes	12 phrases	
	Arm Movements	18 phrases	
	Breathing	6 phrases	
	Coordination	6 phrases	
Law			5 phrases
Total			**56 phrases**

13. Determining the time to answer the test

The Authors calculated the appropriate time to answer the cognitive achievement test while applying it to the exploratory study sample by calculating the minimum and maximum time. The following table shows the average time to answer the test, which took (45) minutes to answer it.

Table (9) Time to answer the cognitive test Data collection tools (N=11)

Test time	Experimental time		Total	Average time
	Least time	Longest time		
	40 minutes	50 minutes	90 minutes	45 minutes

14. Publish the cognitive test in its electronic form

The test was published electronically using Google Forms at the following link: https://docs.google.com/forms/d/1D6Aq_EgVAzB-N9chc0W4b77OqpCurahOkAA4gn-NBXw/edit#settings .

Statistical Analysis

1. average.
2. Median.

3. Standard deviation.
4. skewness.
5. ease, difficulty, and discrimination coefficients.
6. correlation coefficient.
7. split-half.

Results

Based on the research question and objective, the Authors presented the results in a manner consistent with the data obtained. (56) phrases have been reached that measure the cognitive aspect of the swimming course according to the steps followed in constructing the test, as shown in Table (8).

The Authors applied the electronic cognitive test to (211) female students from the first year of the Faculty of Physical Education - University of Sadat City after completing the course on Monday, February 19, 2024, and their number was (211) female students from the first year at a rate of (27.80%) and registered in the academic year (2023-2024) to ensure the achievement of the research question. Table (10) and Figure (1) show the results of applying the electronic cognitive test..

Table 10. Normal distribution of the research sample in cognitive achievement test (N=211)

Axis			Unit of measure	average	Median	Standard deviation	skewness
Cognitive Achievement Test	History Axis		(3) Grades	0.73	1	0.45	-1.84
	Crawl swimming	Body Position	(6) Grades	2.45	2	0.5	2.73
		Arm Movements	(18) Grades	3.04	3	0.84	0.15
		Leg Strikes	(12) Grades	5.09	5	0.81	0.32
		Breathing	(6) Grades	1.66	2	0.64	-1.6
		Coordination	(6) Grades	1.63	2	1.06	-1.06
		Total	(48) Grades	13.92	14	1.82	-0.12
	Law Axis		(5) Grades	1.64	2	0.66	-1.66
	Total score for the cognitive test		(56) Grades	16.28	16	2.05	0.40

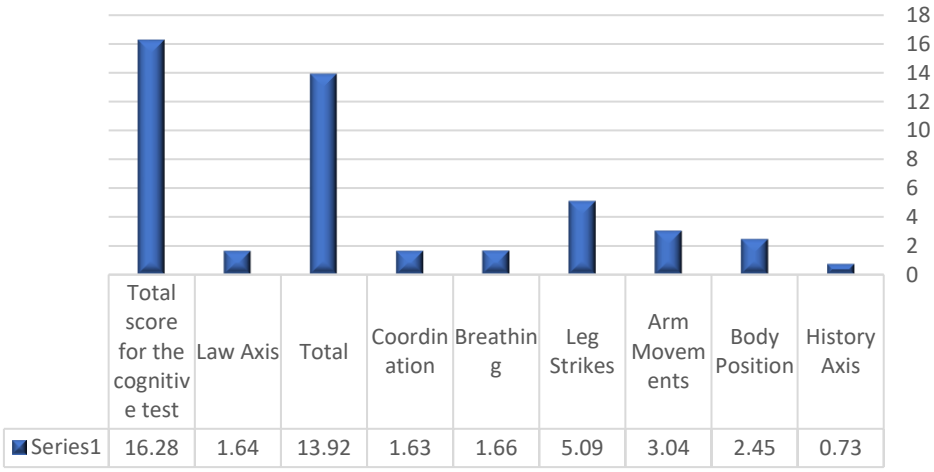

Figure 1. Statistical description of the research sample individuals in the electronic cognitive test Presentation and discussion of the hypothesis results

Table (10) and the data that represents it in Figure (1) clearly show the homogeneity of the research sample individuals in the cognitive test axes "swimming history, skill performance, law," where the values of the skewness coefficient were limited between (±3), which means the moderation of the scores of the research sample individuals in the electronic cognitive test.

The authors believe that electronic tests are one of the most important means of measuring the cognitive aspect and have become one of the requirements of the era in which we live. Through technological progress and development, it has become necessary for us to develop the various methods and means of assessment in general and the field of cognitive achievement in particular.

These results agree with (Hassan, 2009), (Ziada, 2015) regarding the efficiency of electronic tests in measuring cognitive achievement, as well as the tremendous technological progress and development of the era of technology and information, which was reflected in the ability of female students to use modern communication devices and mechanisms from computers, mobile devices and Internet networks.

Conclusion

The number of test phrases was (56) phrases, (3) phrases to measure the history axis, (48) phrases to measure the skill performance axis for crawl swimming, and (5) phrases to measure the law axis. The test time was (45) minutes. When applying the test to the research sample, the rates of skewness in the normal curve were.

Recommendations

The need for those in charge of teaching in general and the field of swimming in particular to pay attention to electronic tests. The possibility of using the proposed test to measure cognitive achievement in crawl swimming. The need to work on building electronic tests for cognitive achievement in other sports. The educational evaluation processes must be continuously developed by reviewing everything new.

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