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Sensor-based Reactive Agility Measurement Tool for Net Game Group Sports: Content Validity
Herramienta de medición de agilidad reactiva basada en sensores para deportes grupales de juegos en red: validez del contenido

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Abstract. It is challenging to develop a measurement of Reactive Agility because the latter is one of the physical components that is highly influenced by internal and external factors. It is thus difficult to perform related measurements due to uncertainties in open game conditions, specifically in the net game group. The purpose of this research is to validate the content of a sensor-based Reactive Agility measurement tool in net game group sports. In terms of the research method, the researchers used a mixed-method approach, combining qualitative and quantitative methods. The research subjects consisted of seven academic and professional experts in the net game group sports. While the data collection technique used is the Delphi technique, related data were collected using a four-scale rating, whereby scale 1 indicated "not suitable", scale 2 "indicated less suitable"; scales 3 and 4 "indicated "suitable", and "highly suitable" respectively. For this validation, the data analysis was conducted using Aiken's formula. As research results, a definition of the Reactive Agility measurement tool and a very satisfactory content validity blueprint for the construction of a Reactive Agility measurement tool for the net game sports group were obtained. Which all aspects have high content validation because the V value is higher than Aiken's standard value (0.76). The respective values for each aspect include; conceptual definition V = 0.952, measuring tool construction V = 0.952, sensors show a value of V = 0.905, test procedures V = 0.905, and scoring V = 0.952.
Key words: Sensor-based, Reactive Agility, Measurement, Net Game, Content Validity

Resumen. Es un desafío desarrollar una medición de la Agilidad Reactiva porque esta última es uno de los componentes físicos que está altamente influenciado por factores internos y externos. Por tanto, es difícil realizar mediciones relacionadas debido a las incertidumbres en las condiciones de juego abierto, específicamente en el grupo de juego de red. El propósito de esta investigación es validar el contenido de una herramienta de medición de agilidad reactiva basada en sensores en deportes grupales de juego en red. En cuanto al método de investigación, los investigadores utilizaron un enfoque de método mixto, combinando métodos cualitativos y cuantitativos. Los sujetos de la investigación estuvieron compuestos por siete académicos y profesionales expertos en deportes grupales de juego de red. Si bien la técnica de recopilación de datos utilizada es la técnica Delphi, los datos relacionados se recopilaron utilizando una calificación de cuatro escalas, donde la escala 1 indicó "no adecuado", la escala 2 "indicó menos adecuado"; las escalas 3 y 4 "indicaron" adecuado "y" muy adecuado "respectivamente. Para esta validación, el análisis de los datos se realizó mediante la fórmula de Aiken. Como resultados de la investigación se obtuvo una definición de la herramienta de medición de Agilidad Reactiva y un modelo de validez de contenido muy satisfactorio para la construcción de una herramienta de medición de Agilidad Reactiva para el grupo de deportes de juego de red. Todos los aspectos tienen una alta validación de contenido debido a que el valor V es superior al valor estándar de Aiken (0,76). Los valores respectivos para cada aspecto incluyen; definición conceptual V = 0,952, construcción de herramientas de medición V = 0,952, sensores muestran un valor de V = 0,905, procedimientos de prueba V = 0,905 y puntuación V = 0,952.
Palabras clave: Basado en sensores, Agilidad reactiva, Medición, Juego en red, Validez de contenido

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Introduction

Reactive agility is a coordinative ability related to skills that must be mastered in sports (Matlák, Rácz, & Tihanyi, 2017), including sports in the net game category (Fernandez-Fernandez, De Villarreal, Sanz-Rivas, & Moya, 2016; Pojskic et al., 2018). Research on competitive performance in net game sports has demonstrated its links to the characteristics of fast short movements, acceleration, and quick changes in direction (Qowiyyuridho, Tomoliyus, & Fauzi, 2021). Attempting to define reactive agility some practitioners insinuated that it refers to rapid whole-body movement with a change in speed and direction after responding to a stimulus (Nugroho, Tomoliyus, Alim, Fauzi, & Yuliarto, 2022). Reactive agility incorporates a cognitive component by involving perception and reaction to cues indicating the direction of a turn (Spiteri, Newton, & Nimphius, 2015). So, reactive agility is related to trainable physical qualities such as strength, speed, power, flexibility, technique, and cognitive components like eye-tracking, visual speed, and anticipation (Inglis & Bird, 2016).

The measurement of Reactive Agility poses a big challenge due to its high dependence on internal and external factors, and there are difficulties in conducting such a measurement due to uncertainties in open game conditions and the lack of reliable measurement protocols (Nóbrega et al., 2023). In other words, the measurement protocols for providing stimuli to change direction are not pre-planned. Considering these facts, several measurement tools have been used to assess reactive agility as a physical capacity in net game sports. Among the tools available, we can list agility protocols with pre-planned direction changes, the arrowhead agility test (Rago et al., 2020), the ladder agility test (Smits-Engelsman, Aertssen, & Bonney, 2019), 505 Agility Test (Luna-villouta et al., 2023), pre-planned agility tests (Sekulic, Uljevic, Peric, Spasic, & Kondric, 2017), Illinois agility test (Pamungkas et al., 2023; Usma-Alvarez, Chua, Fuss, Subic, & Burton, 2011), agility test construction in the Kata category (Danardono,

Kristiyanto, Purnama, Tomoliyus, & Ariani, 2022), and agility test in karate Kumite category (Yudhistira & Tomoliyus, 2020).

However, most of these tests only measure the ability to change direction quickly without including responses to unpredictable or non-reactive external stimuli, which is an important aspect of reactive agility, especially in net game sports (Krolo et al., 2020; Morland, Bottoms, Sinclair, & Bourne, 2013). Net games are a group of games that have relatively similar characteristics based on the tactical approach, skills, and rules used (Mandigo, Lodewyk, & Tredway, 2019). The characteristics of the net game group show short fast movements, acceleration and fast changes in direction (Pojskic et al., 2018; Qowiyyuridho et al., 2021). so reactive agility tests are really needed in net games. Recognizing the limitations of the available tests, we have developed a sensor-based reactive agility measurement tool to assess net game sports groups, including table tennis, tennis, badminton, and volleyball. This research aims to innovate and validate the content validity of the sensor-based reactive agility measurement tool for net game group sports, including table tennis, tennis, badminton, and volleyball.

Methods

The research used a mixed-method approach, combining qualitative and quantitative methods. It utilized an exploratory sequential design, where data collection began with qualitative data and then was followed by quantitative data collection.

Procedure

The research procedure consisted of two stages:

Stage 1 aimed at defining the concept of the reactive agility measurement tool for net game sports groups and developing the construction design of a sensor-based reactive agility measurement tool for net game sports groups. The data sources included relevant documents such as textbooks and articles from internationally indexed Scopus journals related to the research topic. Other data were collected from databases like Mendeley and Google Scholar: in each of these sources, the most relevant topics were selected. Thematic qualitative analysis was used to develop the construction design of the sensor-based reactive agility measurement tool for net game sports groups.

In **Stage 2,** the researchers aimed to validate the design of the sensor-based reactive agility measurement tool for net game sports groups using both qualitative and quantitative methods. Data collection involved the assessment by academic and professional experts using the Delphi technique. The experts consist of 7 experts with the criteria of 3 academic test and measurement expert lecturers and 4 professional experts, namely a coach who has national certificates in tennis, table tennis, volleyball and badminton. The aspects assessed included the suitability of conceptual definitions, operational definitions, sensor compatibility, construction design suitability, clarity of procedures, and scoring accuracy. The instrument utilized a four-scale rating, where scale 1 indicates "not suitable," scale 2 indicates "less suitable," scale 3 indicates "suitable," and scale 4 indicates "highly suitable." Data analysis was performed using Aiken's V index formula. Similar data collection and analysis techniques were used in the development of the Instrument (Garcia et al., 2023)

Research Results

Literature Review Results

Based on the literature review from several international journals using thematic analysis, the resulting concept of sensor-based reactive agility was found to be the speedy direction change in short side steps or sprints after receiving an unplanned stimulus (Inglis & Bird, 2016; Matlák et al., 2017; Nugroho et al., 2022; Spiteri et al., 2015). Additionally, the concept and blueprint for the construction of a sensor-based reactive agility measurement tool for net game sports groups were obtained, as shown in Figure 1 below:

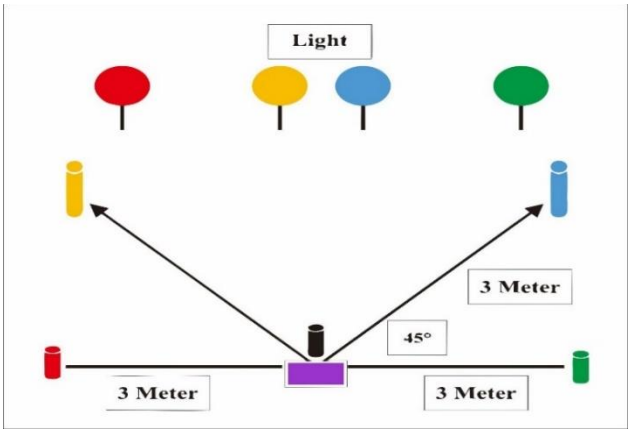

Figure 1. Concept of Sensor-Based Reactive Agility Measurement Tool Construction

Appropriate test equipment and procedures are essential in a test. Figure 1 above explains the concept of Sensor-based Reactive Agility Measurement Tool Construction. There are four lights with various colors. The distance from the testis's starting area or starting position to each cone is 3 meters. The two cones are placed parallel to the start line, while the other two cones are placed in front at an angle of 45. The details of the equipment and mechanism for carrying out the test are as follows;

Equipment

- Four cones of red, yellow, green, and blue colours
- Touch sensor device
- One stopwatch

- Four lights of red, yellow, green, and blue colours

Test Procedure

- The test subject prepares to start in the purple box, facing the four lights.
- The test begins by touching the button in front of them. If the green light is illuminated, test subjects perform a side step towards the green light and touch the cone with their hands. They then sidestep back and touch the start button again.
- If the button, after being touched, has a yellow light illuminated, the test subjects perform a diagonal step towards the yellow light and touch the yellow cone with their hand. They then step back to the starting position and touch the start button again.
- If the button, after being touched, has a blue light illuminated, the test subjects perform a diagonal step towards the blue light and touch the blue cone with their hand. They then step back to the starting position and touch the start button again.
- If the button, after being touched, has a red light illuminated, the test subjects perform a side step towards the red light and touch the red cone. They then step back to the starting position and touch it with their hand (finish).
- Scores are recorded for each section and the total score is calculated from the first to the fourth section.

Results on Content Validity

Content validity results for the sensor-based reactive agility measurement tool for net game sports groups using Aiken's V analysis, as shown in Table 1.

Table 1.
Aiken's V Analysis for the Sensor-Based Reactive Agility Measurement Tool

Expert	Aspect									
	Concept Definition	s	Measurement tool construction	s	Sensor suitability	S	Procedural	s	Scoring	s
A	4	3	3	2	4	3	4	3	4	3
B	4	3	4	3	4	3	4	3	4	3
C	4	3	4	3	4	3	4	3	4	3
D	4	3	4	3	4	3	3	2	4	3
E	4	3	4	3	4	3	3	2	4	3
F	4	3	4	3	3	2	4	3	4	3
G	3	2	4	3	3	2	4	3	3	2
∑		20		20		19		19		20
V		0.952		0.952		0.905		0.905		0.952

Based on the assessment of seven experts, the sensor-based reactive agility measurement tool for the net game sports groups was analyzed using Aiken's V formula, and the results shown in Table 1 imply the following:

- The first aspect, which is the suitability of the concept definition, has a V value of 0.952.
- The second aspect, that is, the construction of the reactive agility measurement tool, has a V value of 0.952.
- The third aspect is the suitability of the sensor; it has a V value of 0.905.
- The fourth aspect, the clarity of the procedure, has a V value of 0.905.
- The fifth aspect, the suitability of the scoring, has a V value of 0.952.

Discussion

The research findings about the Sensor-Based Reactive Agility Measurement Tool corroborate Hendryadi's findings, who stated that a V coefficient of 0.857 indicates adequate content validity (Hendryadi, 2017). In other words, the sensor-based reactive agility measurement tool for group net sports has been endorsed by seven academic and professional experts: their ratings indicate that the tool has a high content validity.

The experts endorsed our reactive agility measurement tool; the latter being a combined measurement tool of reaction and agility, which is highly needed in several sports disciplines, especially net games and invasion game branches (Tran Minh & Nguyen Do Minh, 2019) (Minh, et al., 2019). However, in reality, agility tests conducted so far in the field have indeed mostly been non-reactive agility tests (Azmi & Kusnanik, 2018; Sheppard, Young, Doyle, Sheppard, & Newton, 2006). Therefore, the research aim of validating the reactive agility test tool for the net game sports group was attained. In this study, a mixed approach of qualitative and quantitative methods was used for the content validity assessment (Borrego, Douglas, & Amelink, 2009).

In the first stage, the definition of reactive agility was derived from a literature review with thematic analysis, indicating that it involves the speed of directional change in short side steps or sprints after receiving an unplanned stimulus. Additionally, the concept and construction of the reactive agility measurement tool were illustrated and Figure 1 above is illustrative about this. To ensure the quality of the measurement tool, such a tool needs to possess both content and empirical validity (Aiken, 1985). On the one hand, if the measurement tool used in the research demonstrates high content validity, it means that the tool can effectively fulfil its measuring function according to the intended purpose of the test. On the other hand, a measurement tool with low validity generally produces data that does not align with the test's

intended purpose.

In the second stage, using a quantitative approach, the content validity (Aiken's V) was obtained as follows: the aspect of conceptual definition suitability yielded a V value of 0.952. Equally, the aspect of measurement tool construction showed a V value of 0.95 while the aspect of sensor suitability had a V value amounting to 0.905. What is more, the aspect of test procedure clarity yielded a V value of 0.905, and the aspect of scoring suitability resulted in a V value of 0.952. Comparing these V values to the standard table compiled by Aiken (1985) with four-rating categories and 7 raters, the average Aiken's V standard for this research is 0.76. Therefore, it can be concluded that all aspects of the reactive agility test assessment for the net game group sports have very satisfactory content validity. . The content validity results in this research can be used as a basis for testing with users. The empirical results of the trial will strengthen the validity and reliability of this test.

Conclusion

Based on the results and discussions, it can be concluded that the reactive agility test instrument for the net game group sports has satisfactory content validity according to Aiken's criteria. Which all aspects have high content validation because the V value is higher than Aiken's standard value (0.76). The respective values for each aspect include; conceptual definition V = 0.952, measuring tool construction V = 0.952, sensors show a value of V = 0.905, test procedures V = 0.905, and scoring V = 0.952. Thus, this instrument can be used to measure the reaction agility of athletes in the net game group sports. It is recommended to further strengthen the instrument by conducting empirical validity and test-retest reliability assessments.

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