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ORIGINAL

INSTRUMENT FOR MEASUREMENT OF DECLARATIVE AND PROCEDURAL KNOWLEDGE IN BASKETBALL

INSTRUMENTO DE MEDICIÓN DEL CONOCIMIENTO DECLARATIVO Y PROCEDIMENTAL EN EL BALONCESTO ESCOLAR

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ABSTRACT

The purpose of this study has been the design and validation of an instrument for the evaluation of declarative and procedural knowledge in an invasion sport such as basketball in the school context. 15 expert judges participated in the validation process. The instrument consisted of 34 items distributed in two blocks, declarative and procedural. Answers the following type of questions: Is it useful for?, What is it ?, What is achieved ?, Which one is it? In addition, how is it done? Content validity was calculated using Aiken's V coefficient and its confidence intervals. Cronbach's α coefficient was used for internal consistency. None of the questions that make up the declarative and procedural knowledge test were eliminated by exceeding the exact critical value (V≥.74). The internal consistency of the questions was excellent (α=.95). Therefore, the instrument is valid and reliable for the evaluation of knowledge in school basketball.

KEYWORDS: Validation, expert judge, declarative and procedural knowledge, basketball, Aiken V.

RESUMEN

El propósito de este estudio fue diseñar y validar un instrumento para la evaluación del conocimiento declarativo y procedimental en un deporte de invasión como el baloncesto en el contexto escolar. En el proceso de validación participaron 15 jueces expertos. El instrumento estuvo formado por 34 ítems distribuidos en dos bloques, declarativo y procedimental. Responde al siguiente tipo de preguntas: ¿Qué es?, ¿Sirve para?, ¿Qué se consigue?, ¿Cuál es? y ¿Cómo se realiza? La validez de contenido se calculó mediante el coeficiente de *V de Aiken* y sus intervalos de confianza. Para la consistencia interna se empleó el coeficiente *α de Cronbach.* Ninguna de las preguntas que componen el test de conocimiento declarativo y procedimental fue eliminada al superar el valor crítico exacto (*V*≥.74). La consistencia interna de las preguntas fue excelente (*α*=.95). Por tanto, el instrumento es válido y fiable para la evaluación del conocimiento en el baloncesto escolar.

PALABRAS CLAVES: Validación, juez experto, conocimiento declarativo y procedimental, baloncesto, *V de Aiken*.

INTRODUCTION

Sport instruction forms an essential part of the pedagogical responsibilities of Physical Education teachers (Castejón, 2015). Specific sport learning modalities have been identified by instructors as having high potential to achieve the intended learning goals and to strengthen student understanding. The determination of the specific subject matter depends upon a variety of considerations, including the instructor’s background; the conceptual or overall

value of instruction in a given subject matter area; students' previous learning experiences; the perceived educational value provided by the sport activity itself; and the availability of resources for the delivery of the instructional opportunities within the educational setting (Feu et al., 2010).

The unique characteristics of invasion sports make them the most widely used type of activity in Physical Education classes (Otero et al., 2014). One such invasion sport is basketball, in which teams compete and cooperate within a shared space (Hernandez, 1994). Basketball is also one of the most highly valued educational activities in that it provides opportunities for the development of personal relationships; contributes to advances in the perceptual and decision-making processes; provides a stimulus for motor development; and can stimulate the acquisition of positive values, all of which have educational value (Ibáñez, 2000).

Research about teaching/learning methodologies and student learning about sport are two of the topics most frequently studied at the present time in sport pedagogy (Abad et al., 2013; García-Ceberino et al., 2020; González-Espinosa, Ibáñez, & Feu, 2017). Various investigations have directed attention toward the instructor/student interaction during learning situations that use the Integral analysis system of training tasks in invasion games (SIATE, acronym in Spanish) approach (Ibáñez et al., 2016). These studies have assessed the design of learning tasks by instructors in relation to the specific skills that are essential in the game of basketball (Feu et al., 2019; Gamero et al., 2020; Ibáñez et al., 2015) and the external load of tasks (González-Espinosa et al., 2020; Ibáñez et al., 2015). It is important to know the sports planning process in the initial training stages as they are the basis of future learnings (Cañadas & Ibáñez, 2010).

According to Pérez et al. (2008), the capacity to conduct a more thorough evaluation of learning in invasion sports, such as in basketball, requires an assessment approach that encompasses multiple domains. Traditionally, the assessment of learning in sport has been conducted through isolated, closed tests or motor ability assessments (González-Espinosa, Feu, et al., 2017). However, these types of assessments are limited in their usefulness in invasion sport activities if they lack the capacity to assess decision-making processes that occur during typical practice conditions and actual game play (Oslin et al., 1998).

It is currently recognized that evaluation and assessment processes that include considerations of both declarative and procedural knowledge by students are essential to measure the cognitive components necessary for students to participate satisfactorily in invasion sports. Consequently, additional instruments have been developed that are representative of a more comprehensive knowledge paradigm (Otero et al., 2012; Serra-Olivares & García-López, 2016). Specific tools have been developed for use in basketball, such as the Basketball Learning and Performance Assessment Instrument (BALPAI) (Ibáñez et al., 2019) or the tactical knowledge test for 3vs3 play (Pérez-Morales et al., 2017). These instruments have commonly been utilized in research for the goal of

evaluating student progress in the educational context. Studies that have utilized the BALPAI, such as those conducted by González-Espinosa et al. (2019) and González-Espinosa et al. (2019), have identified differences in the process of learning basketball in relation to the instructional methodology employed, as well as in relation to other variables, such as the gender of the student.

Researchers have an interest in assessing both declarative and procedural knowledge development. Declarative knowledge within the sport pedagogy context refers to an understanding of the basic structure of the sport in terms of rules, objectives and general game play. In short, declarative knowledge refers to the knowledge and understanding that a student needs to have to know "what to do" in order to participate in the sport. On the other hand, procedural knowledge can be considered as the extent of understanding of the more conceptual, tactical and strategic components of the game. Procedural knowledge can be conceptualized as the type of understanding that pertains to the individual's knowledge of the tactics of the game after the student has the essential basic knowledge "how to"(Kump et al., 2015; Otero et al., 2012). This framework for understanding both types of knowledge carries with it the understanding that the conceptual understanding of the game is stored in memory and will enable the student to control and regulate their actions in relevant current and future game circumstances (Sternberg, 2000).

There has been considerable research interest in the cognitive skills that underlie success in invasion sports, which has led to the development of measurement tools for their assessment (McPherson & Kernodle, 2007). However, the bulk of this research has been conducted within the context of professional sport given that coaches have the responsibility of maximizing sport-based knowledge and resultant performance of their players. The sport-related research has contributed to our understanding about the processes by which procedural knowledge is gained (Alarcón et al., 2011; García-Martín et al., 2016). García and Ruiz (2003) assessed the relative importance of declarative and procedural knowledge in the process of learning acquisition in the sport of team handball. In related research, García-Ceberino, Gamero, et al. (2020) examined teaching/learning models that best produced both types of learning in school-based soccer instruction. Iglesias et al. (2005) assessed the effects of reflexive evaluation on decision-making and passing execution skill by youth basketball players. Nonetheless, there have been few investigations that have attempted to examine declarative and procedural knowledge acquisition in the learning of basketball in school contexts.

Improvements in the means of assessment of learning of team sports can enable instructors to make better judgements about their teaching approaches and assist them in the design of teaching methodologies that will facilitate suitable learning activities in the Physical Education setting (Ibáñez et al., 2019). In addition, learning and evaluation efforts can be better connected to each other which will enable students to focus on important elements of the learning process and contribute to greater consistency in the design of the teaching/learning process (Grehaigne et al., 2005). Given that few valid instruments exist which are appropriate for the evaluation of students'

knowledge in the early phases of learning in invasion sports, it is essential that further efforts be made to generate and validate such instruments.

Consequently, the purposes of this investigation are to: i) develop a measurement tool that will facilitate the assessment of declarative and procedural knowledge in the early phases of learning in the sport of basketball in school-aged players; ii) establish the validity and internal consistency of this instruments to determine whether it is appropriate for use in the intended setting.

MATERIALS AND METHODS

Design

The present study fits within the category of investigations known as *instrumental studies* (Ato et al., 2013) that have the objective of assessing psychometric properties of new measurement tools. The purpose of this study was thus to refine and validate a measure of sport knowledge that included both declarative and procedural dimensions of learning in order to generate a valid and reliable tool (Corral, 2009) that can be used to assess student learning during school-based instruction in the game of basketball.

Sample

A purposeful, intentional sampling procedure was used in the present study and conducted in accordance with inclusion criteria identified by previous researchers in the field (Skjong & Wentworth, 2001). Subject matter experts were recruited to provide appropriate insights and recommendations designed to enhance the quality of the study (Cassepp-Borges et al., 2010). The availability and willingness of qualified individuals to contribute was essential to the successful completion of the project (Valle, 2003). Contact was initially made via email over a period of four months with a pool of 29 individuals with expertise in the subject matter and who met the inclusion criteria. Of the 29 individuals, 15 (52%) expressed a willingness to participate and, through the use of their feedback, served as the pool of evaluators (Reguant & Torrado, 2016).

In order to be considered as an expert evaluator, individuals had to meet at least four of the five criteria for inclusion that had been established a priori by the researchers. These criteria included: i) attainment of a doctoral degree in the area of sport and physical activity sciences; ii) attainment of the title of Level III sport coach; iii) teaching experience at the university level with specific responsibilities for instruction in invasion sports; iv) ten years or more of experience as an instructor in Physical Education or as a coach in an invasion sport; and v) publication of scientific papers related to the study of instructional models in sport. Table 1 provides the five inclusion criteria and the related qualifications of each of the expert evaluators. Six individuals met all five of the criteria and nine additional individuals met four of the criteria. Ten of the fifteen experts had an academic background specific to the sport of basketball.

Table 1. Selection Criteria.

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15
C1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
C2	X	X	X	X		X	X	X	X	X	X	X	X	X	
C3	X			X	X				X		X	X	X	X	X
C4	X	X	X	X	X	X	X	X	X	X	X	X		X	X
C5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Note: E = Evaluator; C = Criteria

Variables

The instrument's validation process was conducted with primary consideration given to the content validity and internal consistency of the items comprising the instrument.

Content validity

Content validity is defined as the extent to which the items on an instrument adequately assess the object, or construct, of measurement (Thomas et al., 2015). In the present study, the evaluation of the subject matter experts was used as the standard for assessing content validity. These individuals assessed the components of clarity, relevance, and importance (Cassepp-Borges et al., 2010) for each of the questions that were pilot tested. Each potential item was also rated on a 1-10 scale with a score of "1" representing the lowest possible score on that characteristic and a score of "10" representing the highest possible score for the characteristic. In addition, these individuals were asked to provide any additional written comments and suggestions that they felt could be beneficial for improving the instrument.

- *Score for Clarity.* Each evaluator provided a quantitative assessment of the clarity of the written expression for the proposed question.

- *Score for relevance.* Each evaluator provided a quantitative assessment for the extent to which the question was relevant or pertinent to the construct of interest.

- *Score for importance.* Each evaluator provided a quantitative assessment for the extent to which the question was meaningful and important for inclusion on the instrument.

- *Qualitative evaluation.* Open-ended, qualitative suggestions and recommendations were provided by the evaluators where appropriate.

Internal consistency

The internal consistency of the scale was assessed through *Cronbach's α* value. This statistical value provides an index of the reliability of an instrument through an obtained value that represents the extent of intercorrelaton amongst the items on the scale in assessing a given construct of interest (Drost, 2011). Reliability is essential because no instrument can be valid if it is not reliable (Thomas et al., 2015).

Instruments and Materials

Instruments

The measurement tool known as the Test of Declarative and Procedural Knowledge in Basketball (TDPKB) was generated out of the need for an objective means of assessing students' learning in basketball units of instruction within the normal school context. The instrument was developed in relation to the essential instructional content needed for beginning basketball players to play the game at an appropriate beginning level. It was developed in accordance with educational law and policies («Ley Orgánica 8/2013, de 9 de diciembre, para la mejora de la calidad educativa», 2013) as well as with the intervention research practices advocated by González-Espinosa, Ibáñez, and Feu (2017).

The TDPKB is a written instrument that takes approximately 50 minutes to complete. The students provide responses to a set of demographic questions as well as to questions related to their previous experience in the sport of basketball. The essential part of the questionnaire relates to responses to sets of questions that assess their procedural and declarative knowledge.

The set of questions related to declarative knowledge includes items that test students' understanding of essential knowledge related to the technical/tactical aspects of the sport of basketball, such as questions about basic playing actions and the basic structure of game play. This block of questions consisted of 23 items that are presented in a multiple choice type of format in which the student has three possible response options. The student is asked to identify the specific skill and/or the purpose of the skill within normal play the game of basketball.

A set of procedural knowledge questions was also included on a second subscale. These questions assessed students' conceptual understanding of the game in relation to the resolution of tactical challenges that could be encountered in different game situations. This set of questions consisted of ten questions, with three possible responses to each question, of which only one was correct. Game situations were represented through diagrams that included a guide and a visual image. Questions were introduced in the format of, "If you were player Number One, which option do you feel would be appropriate to resolve (… a given game situation?)".

Materials

The data were compiled through the automated Microsoft Excel 2016 software packet. The free program Visual Basic 6.0, developed by Merino and Livia

(2009), was used for the calculation of *Aiken's V* coefficient value and in relation to the selected confidence intervals. In order to assess the statistical outcomes of the reliability assessment, SPSS 21.0 (SPSS. Inc., Chicago IL, USA) software was used.

Procedure

The study was conducted in three phases. The first phase involved a review of the existing literature to identify previous research efforts that may have been conducted to develop measurement tools for use in instructional settings. Through these efforts, a rough pilot version of the assessment instrument was generated. Subsequently, inclusion criteria relative to the students' participation in the study were generated. Finally, the inclusion criteria for the evaluators were established.

When the sample of expert evaluators had been identified, the process of validating the TDPKB was initiated through electronic mail communication through with them. The evaluators were provided with general information about the purpose of the study and their collaboration and involvement was requested. Guidance was provided for the validation process and the panel provided qualitative feedback on each item on an initial draft of the instrument and individual evaluators were also able to provide feedback about the appropriateness and wording of each item along with any suggested changes. The information provided to the judges explained the age range of the student respondents, the specific purposes of the instrument, and other details to help them proceed.

The individual quantitative values were obtained for each evaluator on the initial version of the instrument and each item was also assessed on the characteristics of clarity, relevance and importance. Additional qualitative feedback was provided by the evaluators on some items. The instrument was modified in accordance with the numerical and open-ended feedback and the content validity of the instrument was subsequently assessed. None of the original items was eliminated but many of these items were modified. Upon analysis of the first set of results obtained, it was necessary to determine whether this version of the instrument was valid in relation to the standards proposed by Ibáñez et al. (2019) and García-Ceberino, Antúnez, et al. (2020). Subsequently, the TDPKB instrument was generated for use with the students (*Appendix 1*).

Statistical analysis

Validity estimates for the declarative and procedural knowledge instruments were estimated through *Aiken's V* coefficient (Aiken, 1985). The value of this coefficient represents the extent of agreement among the expert evaluators. Values fall on a range from .00 to 1.00, with 1.00 reflecting perfect agreement among the evaluators. The calculation of the *Aiken V* value was generated through an algebraic equation that has been modified from the original by Penfield and Giacobbi (2004) as represented below:

$$v = \frac{X - l}{k}$$

The statistical calculations were made through the *Visual Basic 6.0* (Merino & Livia, 2009) software. Addition descriptive statistics were calculated including ranges, means, standard deviations, and the 90%, 95% and 99% confidence intervals through use of the *score method* (Penfield & Giacobbi, 2004).

The critical value needed for *Aiken's V* coefficient (Aiken, 1985), was based upon central limit theorem considerations for larger sample sizes (*m* > 25). The formula is expressed below with the number of evaluators set at 15, and the number of test items set at 33 and with a 10-point response range per item and 95% and 99% levels of confidence (z).

$$v = \frac{z}{0.2\sqrt{\frac{3mn\ (c-1)}{(c+1)}}} + 0.5$$

Table 2 provides the criteria employed for the acceptance, modification or elimination of items. The evaluation criteria conformed with the standards established by Ibáñez et al. (2019) and García-Ceberino, Antúnez, et al. (2020). In this regard, items were to be eliminated if corresponding values fell below the 95% confidence level (*V* < .74); items would be modified if they were within the 95% to 99% confidence intervals (*V* = .74 to .83); and items at the 99% confidence level or above (*V* > .83) were considered ideal and not modified.

Table 2. Criteria for the acceptance, modification or elimination of items.

		Clarity		
		> .83	[.74-.83]	< .74
Relevance	> .83	Accepted	C modified	C modified
	[.74-.83]	R modified	R & C modified	R & C modified
	< .74	Eliminated	Eliminated	Eliminated

The internal consistency of the instrument was assessed through Cronbach's *α* statistic and the resultant values were examined in relation to the acceptance criteria proposed by Field (2009).

RESULTS

The statistical results are presented in Tables 3 and 4 and contain *Aiken V* coefficient values and the 95% and 99% confidence intervals for each of the items that comprised the TDPKB. Separate results are presented relative to the results for declarative knowledge (Table 3) and procedural knowledge scales (Table 4).

Table 3. Declarative knowledge results with *Aiken V* values and confidence intervals

	Clarity						Relevance						Importance					
			95% CI		99% CI				95% CI		99% CI				95% CI		99% CI	
Items	***M±SD***	***V***	***Low***	***High***	***Low***	***High***	***M±SD***	***V***	***Low***	***High***	***Low***	***High***	***M±SD***	***V***	***Low***	***High***	***Low***	***High***
S.P.	9.13±1.13	.90	.84	.94	.82	.95	9.33±1.23	.93	.87	.96	.85	.97	9.33±1.23	.93	.87	.96	0.85	.97
1	8.87±1.92	.87	.81	.92	.78	.93	9.87±.52	.98	.95	1.00	.93	1.00	10.0±.00	1.00	.97	1.00	0.95	1.00
2	9.67±1.05	.96	.92	.98	.90	.99	9.93±.26	.99	.96	1.00	.94	1.00	9.93±.26	.99	.96	1.00	0.94	1.00
3	8.67±2.13	.85	.78	.90	.76	.91	9.47±1.60	.94	.89	.97	.87	.98	9.47±1.60	.94	.89	.97	0.87	.98
4	8.60±2.10	.84	.77	.90	.75	.91	9.80±.77	.98	.94	.99	.92	.99	9.87±.52	.99	.95	1.00	0.93	1.00
5	8.80±1.82	.87	.80	.91	.78	.92	9.80±.77	.98	.94	.99	.92	.99	9.87±.52	.99	.95	1.00	0.93	1.00
6	8.67±2.50	.85	.78	.90	.76	.91	9.87±0.52	.98	.95	1.00	.93	1.00	9.87±.52	.99	.95	1.00	0.93	1.00
7	9.60±.91	.96	.91	.98	.89	.98	10.0±.00	1.00	.97	1.00	.95	1.00	9.80±.56	.98	.94	.99	0.92	.99
8	9.00±2.00	.89	.82	.93	.80	.94	8.80±2.73	.87	.80	.91	.78	.92	8.80±2.73	.87	.80	.91	0.78	.92
9	8.33±2.72	.81	.74	.87	.72	.88	8.93±2.15	.88	.82	.93	.79	.94	8.93±2.15	.88	.82	.93	0.79	.94
10	9.33±1.29	.93	.87	.96	.85	.97	9.53±1.13	.95	.90	.97	.88	.98	9.33±1.45	.93	.87	.96	0.85	.97
11	8.53±2.07	.84	.77	.89	.74	.90	9.73±1.03	.97	.93	.99	.91	.99	9.67±1.29	.96	.92	.98	0.90	.99
12	9.27±1.58	.92	.86	.95	.84	.96	9.40±1.59	.93	.88	.96	.86	.97	9.67±1.29	.96	.92	.98	0.90	.99
13	9.53±.99	.95	.90	.97	.88	.98	10.0±.00	1.00	.97	1.00	.95	1.00	10.0±.00	1.00	.97	1.00	0.95	1.00
14	9.00±2.10	.89	.82	.93	.80	.94	9.93±.26	.99	.96	1.00	.94	1.00	9.93±.26	.99	.96	1.00	0.94	1.00
15	9.27±2.15	.92	.86	.95	.84	.96	9.47±2.07	.94	.89	.97	.87	.98	9.47±2.07	.94	.89	.97	0.87	.98
16	9.13±1.85	.90	.84	.94	.82	.95	8.80±2.68	.87	.80	.91	.78	.92	8.80±2.68	.87	.80	.91	0.78	.92
17	9.80±.56	.98	.94	.99	.92	.99	9.67±.90	.96	.92	.98	.90	.99	9.80±.77	.98	.94	.99	0.92	.99
18	9.27±1.62	.92	.86	.95	.84	.96	9.20±1.70	.91	.85	.95	.83	.96	9.40±1.68	.93	.88	.96	0.86	.97
19	9.64±.93	.96	.91	.98	.89	.99	10.0±.00	1.00	.97	1.00	.95	1.00	10.0±.00	1.00	.97	1.00	0.95	1.00

20	9.33±1.23	.93	.87	.96	.85	.97	9.80±.77	.98	.94	.99	.92	.99	9.73±1.03	.97	.93	.99	0.91	.99
21	9.33±1.40	.93	.87	.96	.85	.97	9.27±1.62	.92	.86	.95	.84	.96	9.13±2.36	.90	.84	.94	0.82	.95
22	9.33±1.40	.93	.87	.96	.85	.97	9.80±.77	.98	.94	.99	.92	.99	10.0±.00	1.00	.97	1.00	0.95	1.00
23	9.00±1.93	.89	.82	.93	.80	.94	8.67±2.50	.85	.78	.90	.76	.91	8.60±2.59	.84	.77	.90	0.75	.91

Note: M = Mean; SD = Standard Deviation; V = *Aiken's V* value; CI = Confidence Interval; Low = Lower Limit; High = Upper Limit; S.P. = Sport Participation.

Table 4. Procedural knowledge results with *Aiken V* values and confidence intervals

	Clarity						**Relevance**						**Importance**					
			95% CI		**99% CI**				**95% CI**		**99% CI**				**95% CI**		**99% CI**	
Items	***M±SD***	***V***	***Low***	***High***	***Low***	***High***	***M±SD***	***V***	***Low***	***High***	***Low***	***High***	***M±SD***	***V***	***Low***	***High***	***Low***	***High***
1	8.93±2.19	.88	.82	.93	.79	.94	9.13±2.36	.90	.84	.94	.82	.95	9.47±1.46	.94	.89	.97	.87	.98
2	8.67±2.16	.85	.78	.90	.76	.91	9.20±2.14	.91	.85	.95	.83	.96	9.47±1.46	.94	.89	.97	.87	.98
3	8.67±2.16	.85	.78	.90	.76	.91	8.87±2.39	.87	.85	.95	.83	.89	9.13±1.85	.90	.84	.97	.87	.98
4	9.93±.26	.99	.96	1.00	.94	1.00	10.0±.00	1.00	.97	1.00	.95	1.00	10.0±.00	1.00	.97	1.00	.95	1.00
5	9.93±.26	.99	.96	1.00	.94	1.00	9.80±.77	.98	.94	.99	.92	.99	10.0±.00	1.00	.97	1.00	.95	1.00
6	9.07±1.73	.90	.83	.94	.81	.95	9.64±1.34	.96	.91	.98	.89	.99	9.67±.90	.96	.92	.98	.90	.99
7	9.93±.26	.99	.96	1.00	.94	1.00	10.0±.00	1.00	.97	1.00	.95	1.00	10.0±.00	1.00	.97	1.00	.95	1.00
8	9.20±1.93	.91	.85	.95	.83	.96	9.47±1.46	.94	.89	.97	.87	.98	9.67±.90	.96	.92	.98	.90	.99
9	9.93±.27	.99	.96	1.00	.94	1.00	10.0±.00	1.00	.97	1.00	.95	1.00	9.80±.77	.98	.94	.99	.92	.99
10	9.93±.26	.99	.96	1.00	.94	1.00	9.80±.77	.98	.94	.99	.92	.99	9.73±1.03	.97	.93	.99	.91	.99

Note: M = Mean; SD = Standard deviation; V = Aiken's V value; CI =Confidence Interval; Low = Lower limit; High = Upper limit.

The obtained results for the dimension of relevance indicated that none of the items on the TDPKB were due for elimination in relation to the stringent a priori criteria of 95% and 99% confidence intervals. Each of the statistical values also exceeded the required critical value (V ≥. 74) which reflected favorably on the content validity of the instrument. For the characteristic of clarity, Question 9 had an *Aiken V* value in the range [.74-.83] that required modification and this modification was made through the input of the evaluators. Table 5 provides the qualitative feedback provided by the evaluators to improve the clarity of various questions.

Table 5. Qualitative input provided by the judges.

Question	Qualitative recommendation	Response
Q7 - Q19 DK	J13-J14-J15. Modify the terminology *unguarded*.	The terminology unguarded changed to moving to get open.
Q5 - Q22 DK	J14-J15. Modify the terminology *driving*.	The terminology *dribbling the ball* was used
Q6 DK	J5-J7-J14-J15 were not in agreement that response "c" was correct.	The original option *c* was eliminated as a response option.
Q9 DK	J2-J3-J4-J13-J14 considered this question to have ambiguity.	The question was rewritten.
Q11 DK	J4-J15. Change the terminology *pressure*.	The terminology was replaced by *defending with high intensity.*
Q20 DK	J5-J15. Given limitations in time of possession change *maximum time allowed* to *maximum time possible.*	The change was made as suggested.
Q23 DK	J3-J7-J14. Question was considered confusing.	The question was rewritten.
DK	J14. Provide explanations to describe the figure in the questions.	Specific explanation was provided about the meaning of the symbols in the graphic figure.
P6 DK	J13-J15. Modify the position of the 2nd defender to be in the passing lane.	The second defender's positioning was changed.
P9 DK	J13-J15. Modify the location of the 2nd offensive player to move them above the 3-point line.	The 2nd offensive player's positioning was modified.

Note: Q = Question; DS=Declarative Knowledge; PK=Procedural Knowledge.

Table 6 provides the results of the assessment of the internal consistency of the declarative and procedural knowledge subscales with the obtained *Cronbach's α* value provided.

Table 6. Internal consistency for the declarative knowledge and procedural knowledge tests.

	Declarative				Procedural				Total			
	C	***R***	***I***	***Total***	***C***	***R***	***I***	***Total***	***C***	***R***	***I***	***Total***
Cronbach α	.91	.86	.79	.95	.84	.89	.92	.95	.91	.90	.83	.95
Valid items	15	15	15	15	15	15	15	15	15	15	15	15
Nº Evaluators	15	15	15	15	15	15	15	15	15	15	15	15

Note: C=Clarity; R=Relevance; I=Importance; D=Declarative; P=Procedural.

The overall TDPKB scale attained a Cronbach α value of .95. These findings indicated that the instrument reached high levels of internal consistency as an index of the scale's reliability.

DISCUSSION

This study consisted of a multi-phase effort to develop and validate an instrument that could be used for the assessment of declarative and procedural knowledge in the sport of basketball with school-aged children within a typical educational setting. It is essential that validated instruments are available for use in these settings as tools for learning assessments.

The design and validation of the instrument proceeded across various phases (Ortega-Toro et al., 2019). The initial phase of the study involved the identification and examination of existing instruments within the knowledge base that have been used for the assessment of declarative and procedural knowledge for use in invasion games in Physical Education and within sport pedagogy contexts (Otero et al., 2012; Serra-Olivares & García-López, 2016). As an outcome of this initial examination of existing measures, a pilot version of the TDPKB instrument was generated. The validation process took place through the participation of a panel of experts. The procedure that was followed was consistent with scientific practice when relying upon a pool of experts with specific attention devoted to establishing the quality of the inclusion criteria; determination of the number of experts required; and modification and refinement of the evaluation tool (Cassepp-Borges et al., 2010; Escobar-Pérez & Cuervo-Martínez, 2008; Ibáñez et al., 2019).

The inclusion criteria involving the selection of the expert evaluators was done to assure that these individuals had the academic and scientific background, as well as the specific content knowledge, necessary to provide the desired quality of input (Rodríguez et al., 1996). The evaluators all demonstrated a high level of academic, investigative and sport-specific content knowledge (Escobar-Pérez & Cuervo-Martínez, 2008). Each of the expert judges had earned a doctorate in the scientific study of sport and physical activity, and had published research related to the design of instructional models in sport. Furthermore, 93.3% of the judges had 10 years or more or experience as a faculty member in Physical Education or as a coach and 86.7% of the judges had reached the highest level of coaching authorized by Spanish law (Feu et al., 2018). Other studies have employed similar

criteria for the selection of expert evaluators (Collet et al., 2019; García-Ceberino, Antúnez, et al., 2020). The expertise of these individuals made an appreciable contribution to the quality of the instrument that was developed.

In instrumental studies, the makeup of the sample is quite relevant and must meet certain standards of quality and include a sufficient number of measured items (Hambleton, 1980). A variety of recommendations have been proposed relative to the minimum number of experts needed to contribute to the validation of an instrument (Lynn, 1886), with a lower level of ten experts deemed to be generally acceptable (García-Ceberino, Antúnez, et al., 2020; González-Espinosa, Ibáñez, Feu, et al., 2017; Ibáñez et al., 2019). This recommendation was exceeded in this study as 15 experts provided oversight and participated in the process. This number also exceeds participatory levels of external evaluators in similar studies (Gamonales et al., 2018; García-Martín et al., 2016; García-Santos & Ibáñez, 2016). The procedure for compiling and evaluating the assessments provided by the expert judges was also similar to procedures employed in similar studies in sport (Collet et al., 2019; García-Ceberino, Antúnez, et al., 2020; González-Espinosa, Ibáñez, & Feu, 2017) and both qualitative and quantitative assessments were obtained.

The qualitative assessment of the items were obtained in relation to the estimation of “clarity”, “relevance”, and “importance” (Cassepp-Borges et al., 2010), and the scores were examined in relation to the critical value needed for *Aiken’s V* statistic. The decision to accept or reject a possible item was established with regard to the critical value needed for large samples (Aiken, 1985) and in relation to accepted confidence intervals (Aiken, 1985; Cicchetti, 1994; Merino & Livia, 2009). The critical value had been calculated through the formula advanced by Aiken (1985) which includes a consideration of the number of evaluators and the number of items as well as the possible response range. This value can be established at the specific 95% CI and the item subsequently modified or rejected in accordance with these confidence intervals (Penfield & Giacobbi, 2004). In this case, it was not necessary to eliminate any of the items. The optimal standard identified for accepting or modifying items for this study at the 99% CI. Other studies have used *Aiken’s V* value of .70 as the criteria for the acceptance of items and this standard can also be considered fairly conservative. The use of the 99% CI can be considered relatively stringent and has been employed in only a few studies (García-Ceberino, Antúnez, et al., 2020; Ibáñez et al., 2019), whereas other similar studies have been less stringent (Collet et al., 2019; García-Martín et al., 2016; García-Santos & Ibáñez, 2016). Attainment of the critical value in validation studies is an important means of establishing the psychometric properties of instruments (García-Martín et al., 2016; Ibáñez et al., 2019; Pérez-Morales et al., 2017) and it is essential that precise criteria be established a priori.

The qualitative evaluations provided by the evaluators enabled improvements to certain questions (Bulger & Housner, 2007), and can be considered an essential element that provided conceptual evidence of validity for the instrument. Although the quantitative data did not indicate that it was absolutely necessary to modify the original instrument, the qualitative contributions provided by the judges provided additional and complementary perspectives on improvement of the measure. In fact, the open-ended, qualitative insights provided by the evaluators facilitated

students' comprehension of the questions while helping to reduce potential errors of interpretation. The approach taken has been commonly used in the instrument validation process (Robles et al., 2016). The open-ended feedback contributed, in particular, to a reduction in ambiguity and the figures that were included helped the students to more concretely identify the situations that were being referred to by the questions posed to them.

For the assessments of the variables of relevance and importance, the basic structure of the questions did not need modification after the initial instrument had been generated. Previous work by investigators in the design of questionnaires for use in similar contexts contributed to the design of the present study. Additional research conducted by García-Santos and Ibáñez (2016), as well as by Gamonales et al. (2018) was beneficial in structuring this instrument. The open-ended qualitative insights were utilized in a coordinated manner to improve the interpretability of the questions and to provide recommendations that the instrument's designers had not previously considered.

Finally, internal consistency assessment was conducted to examine the intrascale reliability of the instruments. These results revealed an overall TDPKB Cronbach α value of .95, which was a strong reflection on the scale's construction. Similar recent studies have also encountered excellent values of internal consistency for instruments used in the evaluation of learning in basketball (Ibáñez et al., 2019) as well as for declarative and procedural knowledge in football (García-Ceberino, Antúnez, et al., 2020). The instrument was designed to include nonredundant items that would contribute to a valid instrument for the assessment of declarative and procedural knowledge of students in the game of basketball. Each item tapped a distinct bit of basic content relative to students' knowledge of the game in basketball, in terms of usefulness, applicability and execution of the skill or decision.

It may be concluded that the TDPKB instrument is a valid and reliable tool that adds to the relatively few existing instruments in the scientific literature capable of evaluating student knowledge of specific sport content within the educational context. Through the use of this tool, it will be possible to conduct more thorough assessments of student learning in basketball. The instrument can be used in conjunction in with other existing measures including the BALPAI (Ibáñez et al., 2019) or the test of tactical knowledge in 3vs3 play (Pérez-Morales et al., 2017). The ability to improve our evaluation assessments within the school environment through appropriate tools is an important contribution to the development of subsequent research-based knowledge and also provides practitioners with an instrument that has great utility value in practice (Pérez et al., 2008). This tool effectively combines theory and practice in sport and, in addition to its capacity for assessing conceptual knowledge, it allows for the evaluation of student learning in relation to actual game play situations and small-sided games of 1vs1, 2vs1, 2vs2 y 3vs3. Previous researchers have attempted to assess declarative and procedural knowledge of sport activities but such instruments have not always been adaptable for use in the educational context (Alarcón et al., 2011; Tallir et al., 2005).

CONCLUSIONS

The purpose of this study was to design and validate an instrument for use in the school environment that could assess the extent and type of learning that occurs during instructional units in basketball.

Quantitatively-based assessments of the instrument provided by evaluators were favorable and open-ended, qualitative comments facilitated modifications and improvements to the tool. Both the declarative and procedural knowledge subscales in the in the TDPKB demonstrated strong indices of validity and reliability.

It can be asserted that this instrument can be used as a tool to aid in the assessment of learning and corresponding gains in knowledge by students, given the favorable psychometric characteristics that were identified. The validation of this type of instrument will allow for its use in practice.

Practical application

This instrument can be applied in educational contexts to provide relevant information to instructors about student learning which, in turn, will allow instructors to modify teaching/learning approaches as needed. In addition, instructors will be able to compare the effectiveness of different methods of instruction on student learning. This instrument can be utilized in educational environments, as well as in sport practice, to evaluate decision-making of young athletes who are beginning their involvement in basketball.

Prospective

The use of this instrument is included as a prospective research in the first cycle of Secondary Education in order to assess students´ learning and analyze the differences found in contrast to the Primary Education stage.

Study limitations

Among the limitations found in this study, it is worth highlighting the small number of studies found that analyze declarative and procedural knowledge in basketball at school time through valid and reliable tests. An analysis of content that put intervention programs into practice was carried out to obtain information about basketball in primary education (González-Espinosa, Ibáñez, & Feu, 2017) and the current educational law (Lynn, 1886).

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TEST OF DECLARATIVE AND PROCEDURAL KNOWLEDGE IN BASKETBALL *(TDPKB)*

First and last name:

Month and year of birth:

Gender:

Age category in which you compete:

How much do you play basketball? (Circle an answer)

1. Never. 2. Rarely. 3. Sometimes. 4. A fair amount. 5. A lot.

How many years have your practiced basketball? (Circle an answer)

0 years. 1 year. 2 years. 3 years. 4 years. 5 years. More than 5 years.

How many years have you competed in basketball? (Circle an answer)

0 years. 1 year. 2 years. 3 years. 4 years. 5 years. More than 5 years.

What level of play do you believe you have reached in basketball? (1 = very low, 10 = very high) (Circle an answer)

1 2 3 4 5 6 7 8 9 10

How much do you enjoy playing and practicing basketball? (1 = a little, 10 = a great deal) (Circle an answer)

1 2 3 4 5 6 7 8 9 10

Have you participated in another invasion sport (football, team handball, hockey, etc.) other than basketball? Which invasion sport(s) and how long have you participated?

SUBSCALE I: DECLARATIVE KNOWLEDGE TEST

QUESTIONS FOR YOUR RESPONSE

CIRCLE THE CORRECT ANSWER OR ANSWERS

Attention! For some questions there is more than one correct answer.

1) The shot is done to:

a) Maintain possession of the ball.
b) Make a basket.
c) Make progress toward the opponent's basket.

2) Changing hands with the ball is done to:

a) Maintain possession of the ball.
b) Shoot a basket.
c) Advance toward the opponent's basket.

3) The pass is done to:

a) Maintain possession of the ball.
b) Shoot at the basket.
c) Advance toward the opponent's basket.

4) Dribbling is done to:

a) Maintain possession of the ball.
b) Shoot at the basket.
c) Advance toward the opponent's basket.

5) Protective dribbling is done to:

a) Maintain possession of the ball.
b) Shoot the ball.
c) Advance toward the opponent's basket.

6) Moving toward the opponent's basket is done to:

a) Maintain possession of the ball.
b) Try to score a basket.
c) Advance toward the opponent's basket.

7) Moving to get open is done to:

a) Find an open space in which to receive the ball.
b) Shoot at the basket.
c) Advance toward the basket.

8) What should a player do to try to make a basket?

a) Maintain possession of the ball.

b) Shoot at the basket.
c) Advance toward the opponent's basket.

9) A fake is:

a) The ability to move past a defender with the ball under total control.
b) Dribbling the ball from one place to another.
c) The ability to make movements that deceive the defense and make them ineffective.

10) What is the purpose of a block?

a) To impede the offensive player's movement to the basket.
b) To impede the offensive player and to stop their shot
c) To impede the offensive player and to eliminate their opportunity to pass.

11) When a team defends with high intensity, what are they trying to accomplish?

a) Steal the ball from the offensive team.
b) Create complications for the offensive team.
c) Enable their own team to shoot.

12) What is the goal when offensive players move into open spaces on offense?

a) Enabling a teammate to have a passing lane.
b) To receive the ball and shoot without a defender.
c) To make it easier for the defensive player to steal the ball.

13) In order to throw a long pass, which type of pass is most beneficial?

a) Baseball pass /over the top pass
b) Chest pass
c) Bounce pass

14) The bounce pass is beneficial for:

a) Stealing the ball as a defender.
b) Making it easier for a teammate to catch the ball.
c) Shooting the ball.

15) When I help out a teammate on defense, the purpose is to:

a) Make for a stronger defense with the two players complicating the offense.
b) Prevent the offensive player from getting to the basket.
c) Let my teammate stop playing defense.

16) Which of these options is best for shooting at the basket?

a) Shooting the ball off of the ground/jumping.
b) Shooting after getting closer to the basket.
c) Throwing a baseball pass.

17) A pass is:

a) Using your hand to send the ball toward the basket.
b) Sending the ball to a teammate.
c) Controlling the ball by hand from one place to another.

18) A shot at the basket is:

a) Sending the ball toward the basket with the objective of putting the ball through the basket.
b) Passing the ball to a teammate after stealing the ball from the opponent.
c) Sending the ball to a teammate.

19) Moving to get open is:

a) A move by a player without the ball to occupy an open space.
b) A move by the player with the ball to occupy an open space.
c) A move by the player with the ball to take a shot at the basket.

20) Maintaining possession of the ball is:

a) Trying to make a basket
b) Moving toward the opponent's basket
c) Protecting the ball to use the maximum time possible.

21) Creating situations of greater numbers of the attack are:

a) The movements of the offensive players for the purpose of having more offensive players than defensive players.
b) The movements of the defensive players for the purpose of having more defensive players than offensive players.
c) The movements of the offensive players to create greater space among them.

22) Dribbling the ball refers to:

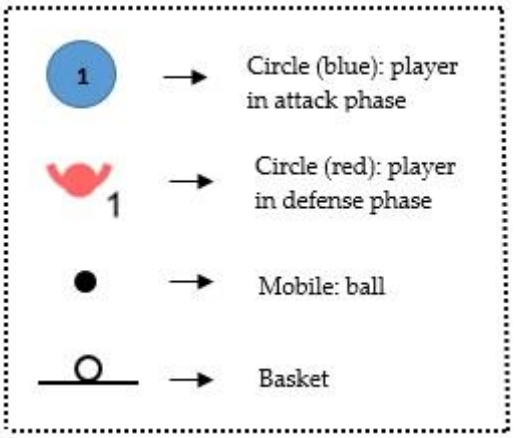
a) Controlling the ball by hand by bouncing it toward the floor to move it from one spot to another.
b) Striking the ball with one's hand toward the opposing basket.
c) Protecting the ball with one's body.

23) How should a player do a protective dribble?

a) Anticipating the opponent's actions if they attempt to steal the ball.
b) Controlling the ball by dribbling it from one place to another.
c) Protect the ball by putting my body between it and the defender

SET II: TEST OF PROCEDURAL KNOWLEDGE

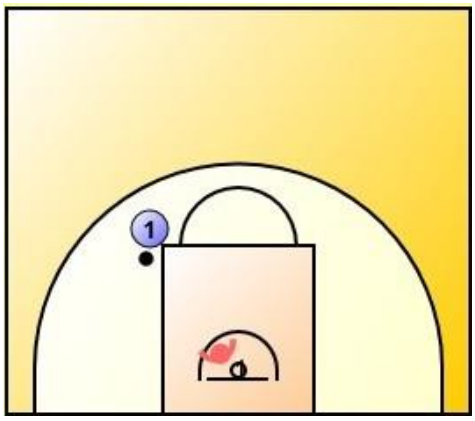
Guide:



QUESTIONS TO ANSWER

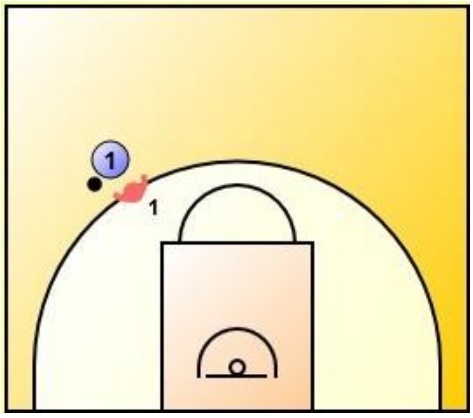
CIRCLE THE CORRECT ANSWER

1) If you were Player 1, which option do you think would be best in the game of 1vs1?



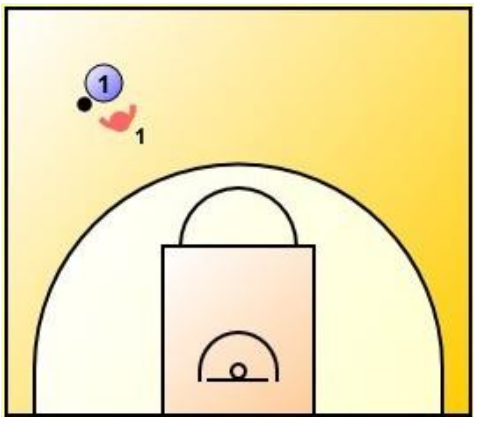
a) Dribble toward the basket
b) Pass to a teammate
c) Shoot at the basket

2) If you were player Number 1, which option do you think would be best in the game of 1vs1?



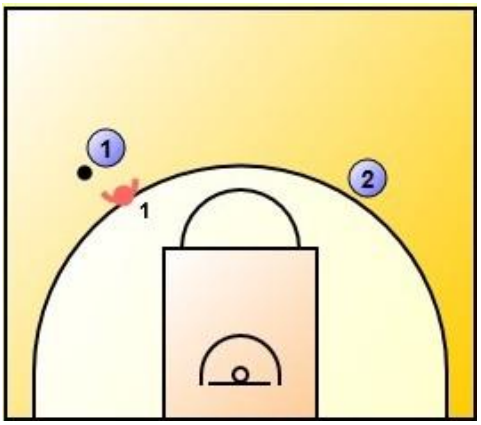
a) Dribble toward the basket
b) Pass to a teammate
c) Shoot at the basket

3) If you were Player 1, what do you think would be the best action in this 1vs1?



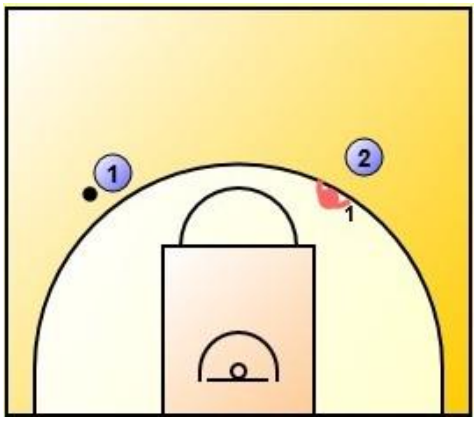
a) Dribble toward the basket
b) Pass to a teammate
c) Shoot at the basket

4) If you were Player 1, which option do you think would be most correct in the game of 2vs1?



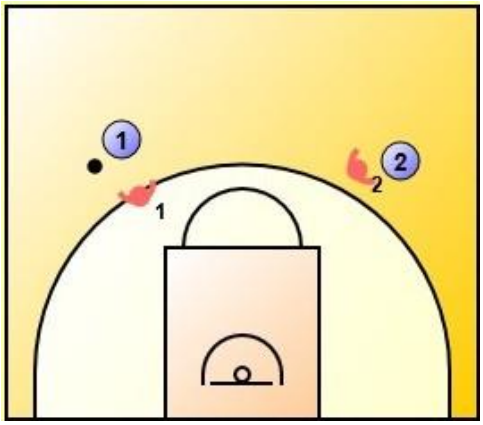
a) Dribble toward the basket
b) Pass to a teammate
c) Shoot at the basket

5) If you were Player 1, which option do you think would be most correct in the game of 2vs1?



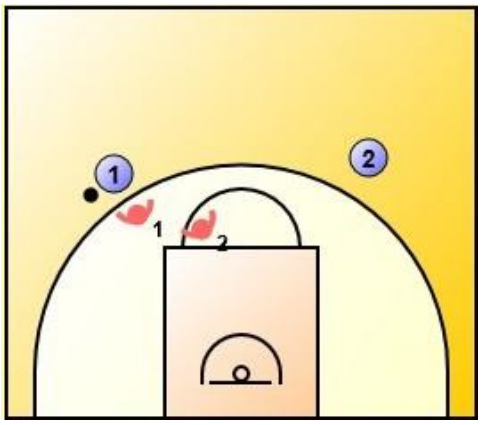
a) Dribble toward the basket
b) Pass to a teammate
c) Shoot at the basket

6) If you were Player 1, which option do you think would be most correct in the game of 2vs2?



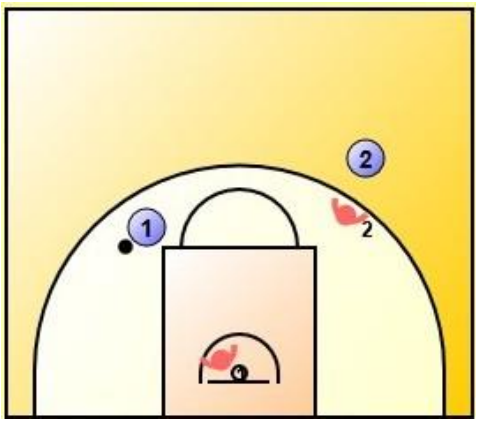
a) Dribble toward the basket
b) Pass to a teammate
c) Shoot at the basket

7) If you were Player 1, which option do you think would be most correct in the game of 2vs2?



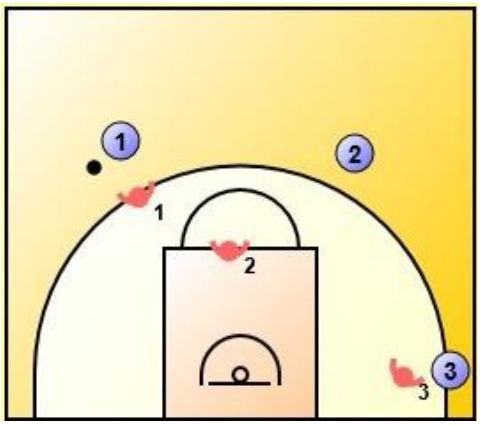
a) Dribble toward the basket
b) Pass to a teammate
c) Shoot at the basket

8) If you were Player 1, which option do you think would be most correct in the game of 2vs2?



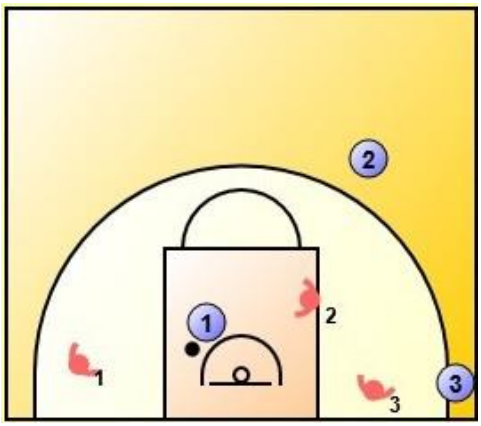
a) Dribble toward the basket
b) Pass to a teammate
c) Shoot at the basket

9) If you were player Number 1, which option do you think would be most correct in the game of 3vs3?



a) Pass the ball to Teammate # 2
b) Pass the ball to Teammate # 3
c) Shoot at the basket

10) If you were player Number 1, which option do you think would be most correct in the game of 3vs3?



a) Pass the ball to Teammate # 2
b) Pass the ball to Teammate # 3
c) Shoot at the basket

Table 7. Correct answers on the *TDPKB*.

Test	Questions	Correct answers
Test of Declarative Knowldge	nº 1	Answer b
	nº 2	Answer a
	nº 3	Answer a - c
	nº 4	Answer a - c
	nº 5	Answer a
	nº 6	Answer b
	nº 7	Answer a
	nº 8	Answer b
	nº 9	Answer c
	nº 10	Answer b
	nº 11	Answer a - b
	nº 12	Answer a - b
	nº 13	Answer a
	nº 14	Answer b
	nº 15	Answer a - b
	nº 16	Answer a - b
	nº 17	Answer b
	nº 18	Answer a
	nº 19	Answer a
	nº 20	Answer c
	nº 21	Answer a
	nº 22	Answer a
	nº 23	Answer c
Test of Procedural Knowledge	nº 1	Answer c
	nº 2	Answer a
	nº 3	Answer a
	nº 4	Answer b
	nº 5	Answer a
	nº 6	Answer a
	nº 7	Answer b
	nº 8	Answer c
	nº 9	Answer a
	nº 10	Answer c