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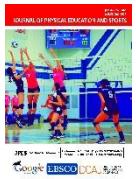

The Development of Virtual Reality-Based Basketball Arbitration Simulation Tools

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Abstract

The use of science and technology development in sports has an important role in updating referee's knowledge. One of them is media application in basketball which is applied in the form of virtual reality web tools and applications. The virtual reality web tools and applications are designed to facilitate in determining the signals of violations during basketball games. This research is development research. The new product development procedure includes analysis of: the product which will be developed, developing the initial product, expert validation and revision, small-scale trials and revision, large-scale trials, and the final product. The data collection was carried out using questionnaires obtained from expert evaluation, as well as using field observations obtained from basketball referees. The data analysis technique used descriptive percentage analysis. The results of the research on the use of virtual reality web tools and applications obtained results by material experts I, II, and III overall get the "very good" category, with an average score of 4.7. In the small-scale trial, the referee scored the "very good" with a percentage of 97%. In a large-scale trial, the referee received the "very good" category rating with a percentage of 97%. Based on the results, it can be concluded that the product development tools and virtual reality web applications can facilitate the referees to determine violation signals in the implementation of basketball games. Regarding the virtual reality web tools and applications development, It is expected that it can begin to be applied in basketball and bring up new ideas for the virtual reality web tools and applications development.

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INTRODUCTION

Basketball is a team sport where two teams, usually consisting of five players on each team, play against each other on a rectangular court. The aim of each team is to score in the opponents' basket and to prevent the other team from scoring. The game is controlled by the referees, table officials, and a commissioner, if present (*FIBA rule* 2017:3).

Basketball matches can proceed well because of the official regulations from *FIBA (International Basketball Federation).* The official basketball rules for 2017 have eight rules, namely: The first rule is regarding matches. It is the rule that governs basketball matches, the opponent's basket, the own basket, and the winner of the game; The second rule, regarding the playing court and equipment, is the regulation that governs the playing court for the backcourt, frontcourt, court lines, position of table officials, substitution chairs and match equipment; The third rule, regarding the team, is the regulation that governs the team, injured players, the captain duties and powers, and the coach duties and powers; The fourth rule, regarding playing regulations, is the regulation that governs the playing time, tied score and overtime, beginning and end of a quarter, overtime or the game, status of the ball, location of the player and the referee, jump ball and alternating possession, how the ball is played, the control of the ball, player in the act of shooting, the goal: When made and its value, throw-in, time-out, substitutions, game lost by forfeit, and game lost by default; The fifth rule, regarding violations, is the regulation that governs violations or deviations from the rules, Player out-of-bounds, ball out-of-bounds, dribbling, traveling, 3 seconds, closely guarded player, 8 seconds, 24 seconds, ball returned to the backcourt, and goaltending and interference; The sixth rule, regarding fouls, is a rule that governs contact, general principles, personal foul, double foul, technical foul, unsportsmanlike foul, disqualifying foul, and fights; The seventh rule, regarding general provisions, is a rule that governs 5 fouls by a player, special situations, free throws, and Correctable errors; The eighth rule, regarding the power and duties of referees, table officials, commissioner, is the regulation that governs the referees, table officials and commissioner, referee duties and powers, scorer and assistant scorer duties, timer duties and shot clock operator duties (Official Basketball Rules FIBA, 2017).

A referee needs to understand and master the general basics of refereeing theory. Understanding and mastering the general basics of refereeing theory means providing a referee with inner stability or increasing the referee's confidence in refereeing, which means helping the smoothness and success of his refereeing activities (Indra Darma Sitepu, 2016: 79).

Nuril Ahmadi (2007: 69) argues that basketball referees in Indonesia are determined by Perbasi Management. In this case, PB Perbasi is assisted by the referee commission. The rights and obligations of the referee commission are to upgrade, appoint, cease referees from level C to A, and propose the referees to take the international referee test.

A referee must be able to recognize incidents on the court when he leads the match precisely and rapidly. Incidents that often occur in the court are violations. They are player out-of-bounds, ball out-of-bounds, dribbling violation, traveling violation, 3 seconds violation, 5 seconds violation, 8 seconds violation, 24 seconds violation, backcourt violation, goaltending and interference violation, and jump-ball violation. There are various kinds of fouls in basketball, but the referee does not really understand these fouls. Inaccurate decision making in taking foul still occurs in matches. Therefore, a referee must understand the rules in theory and practice. Practical skills are also considerably needed by a referee as well as understand it in theory. In the basketball rules book, foul is a rule that must be understood

by a referee, so a referee must be able to make rapid and accurate decisions in making the foul. Violation is carried out by personal team while on the court. Besides physical and theoretical basketball which must be qualified, the practical ability in the court in making decisions rapidly and accurately must be taken into account. Hands-on practice is supported by an understanding of the rules.

Research and Development method is a method used to produce a certain product, and test the effectiveness of the product. According to Titting F (2016: 121) "Education and technology must evolve in line to fulfill the challenges of today's development." To produce certain products needs using analysis research and to test the effectiveness of these products to be functionated in the wider community, research is needed for the effectiveness of these products. According to Jujun S Suriasumantri (2007) "Humans are also called Homo Faber (creatures that make tools) besides Homo Sapiens (thinking creatures) which reflect the relationship between theoretical knowledge and practical technology".

Virtual Reality is a computer-based technology that combines special input and output devices so the users can interact deeply with the virtual environment as if they were in the real world. *Virtual Reality* enables developers to create virtual environments with potential simulated ways. When using VR, visualizations which occur in the virtual world consist of visual, auditory, or other stimuli. (Sulistyowati, 2017: 38).

From the description above, the researcher wants to investigate deeply about "The Development of Virtual Reality-Based Basketball Arbitration Simulation Tools".

METHOD

This research is a type of Research and Development (R&D). According to Sugiyono (2014: 407), research and development is a research method used to produce certain products and test the effectiveness of these products. So, it is a method for producing certain products or improving existing products and testing the effectiveness of these products.

Sugiyono (2014: 408) explains that there are ten steps for research and development, namely: 1) Potency and problem, 2) Data collection, 3) Product design, 4) Design validation, 5) Design revision, 6) Product testing, 7) Product revision, 8) Operational field testing, 9) Final product revision, 10) Mass Production. In education, product design such as new teaching methods can be directly tested, validated, and revised. The initial phase of testing was carried out by simulating the use of the teaching method. After being simulated, it can be tested in a limited group. Tests are carried out to obtain information on whether the new teaching method is more effective and efficient than the old or other teaching methods. For testing, it can be accomplished by experimenting. It is comparing the effectiveness of the old teaching method with the new one. Sugiyono, (2015: 415).

This research technique was conducted to collect the data used as a basis for determining the expediency of the product developed by the researcher. The technique of data collection instruments must be determined precisely to obtain accurate data following the problem and research objectives. The stages in testing this product include: 1) determining the trial design, 2) determining the test subject, 3) determining the type of data, 4) regulating the instrument, 5) data analysis techniques.

The data analysis technique in this study is a statistical test of validity and reliability. The formula used in processing percentage data is as follows:

$$P = \frac{\sum xi}{\sum xj} \times 100\ \%$$

Explanation :

P = Percentage

∑xi = Total Rating Score by the Referee

∑xj = Total Maximum Score

100% = Constants

RESULTS AND DISCUSSION

The researchers used three material expert validators, one Unnes basketball lecturer, one national basketball match supervisor, and one basketball referee in Central Java. Classification for material expert validators: 1) Priyanto, M.Pd. Lecturer of basketball at the Faculty of Sports Science, Sports Coaching Education Study Program, UNNES, 2) Agus Waluyo is the supervisor of the national basketball competition, 3) Ary Widijatmoko is a basketball referee in Central Java. Validation data obtained by trying the *virtual reality* web tool on the validator and assessed using questionnaires for basketball material experts.

The validation of material experts is carried out in two stages. The first stage is the evaluation and assessment of the initial product before small-scale trials are carried out. The second stage is the evaluation and validation of small-scale trial products to be tested on a large scale.

The criteria from the results of the basketball material expert I and II were obtained from the results of the qualitative data conversion on a scale of five. The results of the material expert 1 validation showed that the quality of the product, seen from the stage I of material expert 1, was affirmed "very good" with an average score of 4.8. In stage II, the results of the validation by material expert 1, the product quality was affirmed "very good" with an average score of 4.9. The results of the material expert 2 validation showed that the product quality seen from the material expert 2 stage I was affirmed "very good" with an average score of 4.5. In stage II the results of the validation by material expert 2, the product quality was affirmed "very good" with an average score of 4.8. The results of the validation of the material expert 3 showed that the product quality seen from the material expert 3 stage I was affirmed "very good" with an average score of 4.5. In stage II, the results of the validation by material expert 1, the product quality was affirmed "very good" with an average score of 4.8.

The data obtained at the validation stage by basketball material experts, the *virtual reality* web-based basketball simulation tool is suitable for testing in stage I with revisions as suggested from material experts 1, 2, and 3. This virtual reality web tool is also suitable for use in trials without revision at stage II.

Basketball Material Validation Results

The data on the *virtual reality* web tool quality assessment results in stage I, the validation results by the material expert 1 obtained the "very good" rating of 85%, and the "good" rating of 15%. In stage II, the assessment of "very good" gets 92%, and the assessment of "good" gets 8%.

The data on the results of the *virtual reality* web tool quality assessment in stage I by the material expert 2 validation results obtained the "very good" rating of 46%, and the "good" rating of 54%. In stage II, the assessment of "very good" gets 77%, and the assessment of "good" gets a percentage of 23%.

The data on the results of *virtual reality* web tool quality assessment results in stage I by the material expert 3 obtained the "very good" rating of 54% and the "good" rating of 46%. In stage II, the assessment of "very good" gets 85%, the assessment of "good" gets 15%. Criteria from the results of material experts 1, 2, and 3 above were obtained from the results of the conversion of qualitative data on a scale of five.

The results of the material experts 1, 2, and 3 validation showed that the quality of the product as seen in material 1, 2, and 3, stages I and II are affirmed "very good" with an average score of 4.7.

Media Expert Validation Data Results

The criteria for the results of media experts are obtained from the results of qualitative data conversion on a scale of five. The results of the media expert's validation showed that the product quality, as seen on stage I media expert, was affirmed "very good" with an average score of 4.6. In stage II, the results of the validation by the media expert for product quality were affirmed "very good" with an average score of 4.8.

From the data obtained in the validation stage carried out by media experts, the virtual reality web-based basketball arbitration simulation tool is feasible to be used for trials in stage I with revisions as suggested from media experts. Virtual reality web tools can be used in trials without revision in stage II.

Small-Scale Trial Data Results

Small-scale trials were collected from the referees in Semarang Recidency. They are from Kendal Regency, Semarang City, Demak Regency, Semarang Regency, and Salatiga Regency. The small-scale trial place selection is based on the following factors: 1) Fulfilling the research elements (referees), 2) The accessibility. The small-scale trial classifications include: one referee for A license, two referees for B1 licenses, six referees for B2 licenses, and one referee for C license. Field trials were conducted using a virtual reality web-based basketball arbitration simulation tool. One by one, the referee tried the tool by practicing the violation signal that appeared in the video. After all, the referees tried the virtual reality web tool then filled out the questionnaire that was provided by the researchers as data obtained on a small-scale trial. The results of the research obtained from all basketball referees, the quality of the virtual reality web tool obtained a percentage of 97%, included in the "very good" category and by the meaning "used".

Large-Scale Trial Data Results

Large-scale trials were collected from basketball referees in 5 residencies from Central Java. They are Pekalongan Residency, Pati Residency, Surakarta Residency, Kedu Residency, and Banyumas Residency. The selection of large-scale trial places is based on the following factors: 1) Fulfilling the research elements (referees), 2) The accessibility, 3) Representing the referees throughout Central Java. The large-scale trial classifications include: two A licensed referees, one B1 licensed referee, twelve B2 licensed referees, and seven C licensed referees. Field trials were conducted using a virtual reality web-based basketball arbitration simulation tool. One by one, the referees tried the tool by practicing the violation signal that appeared in the video. After all, the referees tried the virtual reality web tool then filled out a questionnaire that was provided by the researcher as data obtained in large-scale trials. The results of the research obtained from all basketball referees, the quality of the virtual reality web tool obtained a percentage of 97%, included in the "very good" category and having the meaning "used".

DISCUSSION

Based on the results of the development of virtual reality L-based basketball arbitration simulation tools analysis, the following results are obtained:

Data Analysis from the Results of Basketball Material Validation

Stage I and II validation by three material experts on *virtual reality* web tools construct data to be analyzed and used as a reference for making revisions. Data obtained through a questionnaire consisted of 13 statement items.

The data from the results of the *virtual reality* web tool quality assessment in stage I by the material expert 1 obtained the "very good"

rating of 85%, and the "good" rating of 15%. In stage II, the "very good" assessment gets 92%, and the "good" assessment gets a percentage of 8%.

Data from the results of the first stage *virtual reality* web tool quality assessment by expert 2 obtained the "very good" rating of 46% and the "good" rating of 54%. In stage II, the "very good" assessment gets 77%, the "good" assessment gets a percentage of 23%.

Data Analysis From the Results of Media Expert Validation

Stage I and II validation by three material experts on *virtual reality* web tools construct data to be analyzed and used as a reference for making revisions. Data obtained through a questionnaire consists of 15 statement items.

The data on the results of *virtual reality* web tools quality assessment in stage I of the media validation gets the results the "very good" rating of 60%, the "good" rating of 40%. In stage II, the assessment of "very good" gets a percentage of 80%, and the assessment of "good" gets a percentage of 20%.

The criteria from the results of the media experts above were obtained from the results of the qualitative data conversion on a scale of five.

The results of the media expert's validation showed that the quality of the product as seen from the media experts in stages I and II was affirmed "very good" with an average score of 4.7.

Data Analysis from The Results of Small-Scale Trial

Data obtained from characteristical small-scale trials is the same as potential product users. The data obtained from small-scale trials is the quality of the product. The data showed the basketball referee's assessment of the product quality developed. The small-scale trial was attended by 10 referees from Semarang Residency.

The referee's assessment of the product quality showed that the product developed had a percentage of 97% as seen from the results of all referees in the "very good" category with the meaning of "used". Data obtained through a questionnaire consisting of 20 statement items.

Data Analysis from The Results of Large Scale Trial

Data obtained from characteristical large-scale trials is the same as potential product users. The data obtained from large-scale trials represent product quality. The data showed the basketball referee's assessment of the product quality developed. The large-scale trial was attended by 22 referees from 5 residencies in Central Java.

The referee's assessment of the product quality showed that the product developed had a percentage of 97% as seen from the results of all referees in the "very good" category with the meaning of "used". Data obtained through a questionnaire consisting of 20 statement items

CONCLUSSION

Based on the results of data analysis and discussion, the following conclusions can be drawn: 1) A product has been produced in the form of the development of a *virtual reality*-based basketball arbitration simulation tool, which can be accessed with a laptop or computer by installing the PBBVR application which will be connected automatically to an android smartphone. 2) The results of the validation from material experts I, II, and III overall get the "very good" category, with an average score of 4.7. The results of the evaluation of the media expert validation overall get the "very good" category, with an average score of 4.7. In a small-scale trial, the referee scored in the "very good" category with a percentage of 97%. In the large-scale trial, the referee received an "excellent" category rating with a percentage of 97%. 3) Producing a product in the form of a virtual reality web tool which is considered effective in assisting the performance of the referee in providing signal decisions during the training.

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