Cypriot Journal of Educational Sciences

Volume 17, Issue 10, (2022) 3834-3848

www.cjes.eu

# Robotic-based takraw blocker technique skill tool: Development and students' perceptions

**John Arwandi** [*], Universitas Negeri Padang, Faculty of Sport Science, Padang, Indonesia, https://orcid.org/0000-0001-9577-3759

**Syahril Bais**, Universitas Negeri Padang, Faculty of Sport Science, Padang, Indonesia, https://orcid.org/0000-0001-7155-5263

**Vega Soniawan**, Universitas Negeri Padang, Faculty of Sport Science, Padang, Indonesia, https://orcid.org/0000-0002-2340-6607

**Suci Nanda Sari** [d], Universitas Negeri Padang, Faculty of Sport Science, Padang, Indonesia, https://orcid.org/0000-0002-3519-4621

**Padli Padli** [e], Universitas Negeri Padang, Faculty of Sport Science, Padang, Indonesia, https://orcid.org/0000-0001-8395-6777

**M. Ridwan** [f], Universitas Negeri Padang, Faculty of Sport Science, Padang, Indonesia, https://orcid.org/0000-0001-8802-0863

**Suggested Citation:**

Arwandi, J., Bais, S., Sari, S. N., Padli, P., Ridwan, M. (2022). Robotic-based takraw blocker technique skill tool: Development and students' perceptions. *Cypriot Journal of Educational Science*. *17*(10), 3834-3848. https://doi.org/10.18844/cjes.v17i10.8248

Received from June 10, 2022; revised from August 25, 2022; accepted from October 18, 2022



**Abstract**

The purpose of this research is to develop a robotic-based block takraw technique skill tool. This research method is a development that uses the ADDIE model. The sample in this study comprised 25 athletes. The research instrument used was an expert validation questionnaire and a student perception questionnaire. The data analysis technique used is descriptive statistics for quantitative data and Miles and Huberman's technique for qualitative data. The results of expert validation of exercise measurement and evaluation tests, takraw expert validation and media expert validation showed very good results where the product developed was feasible to use. The results of students' perceptions of the robotic-based block takraw technique skills showed very good results as well. Therefore, this robotic-based block takraw technique skill tool is very good as a supporting tool in training to improve the smash ability of takraw athletes.

Keywords: Blocker Technique; Development; Perception; Robotics; Skill tool; Takraw

*ADDRESS FOR CORRESPONDENCE: John Arwandi, Universitas Negeri Padang, Faculty of Sport Science, Padang, 25171, Indonesia
*E-mail address*: john.arwandi@fik.unp.ac.id

## 1. Introduction

### 1.1 Conceptual and Teoritical Framework

Optimal achievement development in addition to good and continuous athlete coaching, an athlete's optimal performance, is also influenced by physical, technical, tactical and mental conditions (Russell et al., 2019; Syukur & Soniawan, 2015; Padli et al, 2020; Umar et al, 2022). The results of sports achievements are largely determined by good programme planning and implementation (Jones et al., 2017; Maksymchuk et al., 2020; Sallis et al., 2016; Padli et al). The training programme is an important tool or guide for trainers to use as a guide in planning exercises that must be structured in a targeted, theoretical and timely manner (Ferrero et al., 2019; Gorecky et al., 2017; Harsono, 2004; Hilliard, 2015; Padli et al, 2022). Takraw is a sport that has developed widely and rapidly in today's society (Aji et al., 2021; Hermanto, 2017; Udomtaku & Konharn, 2020; Padli et al, 2022). To be able to play takraw well and beautifully, a player must know and master the technical skills of playing takraw, especially good mastery of technical skills (Hermawan, 2020; Hakman et al., 2018; Kosni et al., 2018). Technical skills are one of the important factors for an athlete because without good technical skills, it is clear that a player will not have good achievements.

In takraw, the technique that is needed and must be mastered by the players is mastering basic techniques and also special techniques. The basic techniques of takraw include silage, kick, tread, head play, grasping and shoulder to shoulder (Astra, 2017; Maseleno et al., 2016; Zulkifli et al., 2019), while the special technique is an advanced technique from the basic technique, namely service, receiving the first ball (*reservice*), *block*, operan (*passing*) and *smash* (Dianawati et al., 2017; Muhyi et al., 2021). All of these must be taught properly and with the correct method if achievement is to be achieved. One of the efforts to improve so that there is a continuous increase in achievement is to make special technical skill tools, especially in blockers or blocking the ball (Achmad et al., 2019; Hanafi, 2020; Pratama et al., 2017).

Block is a movement made to hold the ball or return the opponent's ball either from a smash or heading with the position of the player doing the block approaching the net (Ferrari et al., 2018; Permana et al., 2021; Pichardo et al., 2021). Furthermore, Sahabuddin (2020) states that blocking is one of several defensive work movements. Correct/good blocking is when the blocker can make his block fall in the opponent's area without being able to be returned by the opponent. Usually doubters who have good block skills and the opposing side who does the smash have a hard time making an attack. Thus, we think that the best defence is to block, and for that block needs to be paid attention to by the coaches in the training process (Nata, 2021; Purwanto, 2017).

One of the developing science and technology domains that help exercise activities in sports is robots (Eom & Lee, 2020; Javier Lopez Frias & Luis Pérez Triviño, 2016; Xiao et al., 2017). The implementation of robots so far has been able to help humans in various fields, especially in the industrial sector (Benotsmane et al., 2018; Bragança et al., 2019). Artificial intelligence plays an important role in the world of robotics because it allows robots to move automatically with just simple commands (Raj & Seamans, 2019; Siau & Wang, 2018; Vrontis et al., 2022). The application of artificial intelligence, especially robotics in human daily life, can replace humans in the real world (Nisiotis et al., 2020). To develop the world of robotics even further, researchers are trying to make robots perform various kinds of human-made sports and games. The hope is that robots can act like humans and someday can be used in a wider scope (Fernandez & Hollinger, 2017; Ohairat, 2019).

The application of robots has been widely applied in Japan; many business processes involve robots in their daily business processes, from restaurants to supermarkets; with the application of robots in

various human activities in the future, it cannot be denied that many jobs can be replaced by robots (Kamide et al., 2015; Kovacic, 2018; Nomura et al., 2015; Putra, 2020). Therefore, it is necessary to create or modify the existing tools to adapt to current conditions. With advances in science and technology, a coach will understand and make it easier to analyse and train the latest series of training models so that they will further improve their soccer skills (Torres-Ronda & Schelling, 2017; Wijayati, 2015). Therefore, it is necessary to develop a robotic-based takraw block technique skill tool.

### 1.2 Related Research

Information and communication technology (ICT) demands for changes in various fields including sports. ICT is widely used in physical education and sports science which is able to answer many needs in the field of sports education. Wicaksono and Utama (2020) showed that sports teachers in primary and secondary schools used ICT as a learning medium for sports education but have not been maximised. Furthermore, Hasana et al. (2021) developed an ICT-based audio visual learning media model in PJOK learning for elementary school teachers which shows the results that the resulting product is very feasible to use. Kusuma (2019) applied blocked practice methods and technology-based footwork media that utilise technology in badminton. ICT can be used to develop sports education where one of them is takraw, in line with Nugroho and Sulaiman (2021), who developed android-based takraw learning media for students.

### 1.3 Purpose of The Study

This study aims to design and develop a robotic-based block and smash technique. The urgency of the findings of this study can be used as a reference and recommendation for academics, coaches and takraw stakeholders that this tool can be used as an alternative as a form of exercise that can be used to improve soccer block and smash skills. Based on these objectives, the formulation of the problem in this study are as follows:

1. Is the robotic-based block takraw technique tool developed feasible to use?
2. What are the students' perceptions of the use of robotic-based block takraw technique skills?

## 2. Method and Material

### 2.1. Research Model

This research is a development research using the ADDIE model which consists of (1) analyse, (2) design, (3) develop, (4) implement and (5) evaluate (Agustien et al., 2018; Astalini et al., 2019; Darmaji et al., 2021; Januszewski & Molenda, 2008). The ADDIE model is one of the most commonly used development models in the field of instructional design that serves as a guide in software development (Branch, 2009; Budoya et al., 2019; Stapa & Mohammad, 2019). In accordance with the purpose of the first year of research, namely the product in the form of findings on the feasibility of robotic-based tools that have been empirically tested, the sequence of research work in the first year will focus on tool findings.

### 2.2. Participants

The place of research was carried out at the Padang State University GOR. The research activity was carried out starting from October to November 2021. The sample in the study comprised 25 students who were members of the takraw organisation, Padang State University, who were selected based on the purposive sampling technique. Purposive sampling is a sampling technique with certain considerations or in-depth criteria (Melesse & Mekonnen, 2020; Tegeh et al., 2020). Purposive sampling applied in this study is used to obtain research subjects based on special considerations,

namely research needs or what is expected in research (Aldila et al., 2022; Darmaji et al., 2021). The sample selection in this study was carried out based on special considerations, namely students who are members of the takraw student activity unit at the Padang State University because they understand the game of takraw.

### 2.3. Data Collection

This study uses quantitative and qualitative data. Quantitative data comes from the results of students' perceptions of the product developed and the results of expert validation, while qualitative data comes from the interviews. The research instrument used was a student perception questionnaire and an expert validation questionnaire. The student perception questionnaire grids and expert validation questionnaires are shown in Tables 1 and 2.

**Table 1.** Student Perception Grid

| Indicator | Items |
|---|---|
| Physical | 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12 |
| Design | 13, 14, 15, 16, 17, 18, 19, 20, 21 |
| Utility | 22, 23, 24, 25, 26, 27, 28, 29, 30 |

**Table 2.** Expert Validation Grid

| Indicator | Items |
|---|---|
| Physical | 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12 |
| Design | 13, 14, 15, 16, 17, 18, 19 |
| Utility | 20, 21, 22, 23, 24, 25, 26, 27, 28 |

The results of the assessment of the questionnaire were compiled with a 5-point Likert scale, as shown in Tables 3 and 4.

**Table3.** Category of Student Perception Results

| Interval score | Category |
|---|---|
| 30.0–52.5 | Very Bad |
| 52.6–75.0 | Bad |
| 75.1–97.5 | Good |
| 97.6–120.0 | Very Good |

**Table 4.** Category Expert Validation Results

| Interval score | Category |
|---|---|
| 1.00–1.75 | Very Invalid |
| 1.76–2.50 | Invalid |
| 2.51–3.25 | Valid |
| 3.26–4.00 | Very Valid |

### 2.4. Data Collection Process

The research procedure was started by developing a robotic-based block takraw technique skill tool. The development was carried out using the ADDIE development model with the following stages: (1) analyse, (2) design, (3) develop, (4) implement and (5) evaluate. In the analyse and design stages, the analysis and processing of designing a robotic-based block takraw technique will be carried out.

Furthermore, the development of robotic-based block takraw technique skills will be carried out at the develop stage. At the develop stage, the product will be validated by experts to get a valid and good product to use. The experts will fill out the expert validation questionnaire and interviews were conducted during the validation process with the experts.

The products that have been suitable for use will then enter the implementation stage where the products will be used by students who are members of the Padang State University takraw organisation. At the implementation stage, a questionnaire on students' perceptions of the robotic-based block takraw technique skills will be distributed. Next, it enters the evaluation stage which is useful for fixing the weaknesses of the robotic-based block takraw technique skills products that were found. The data from the questionnaires and interviews will then be analysed by researchers to get a conclusion.

### 2.5. Data Analysis

The data analysis technique used in this study consisted of two techniques, namely quantitative and qualitative. The quantitative data technique is carried out with descriptive statistics by calculating the mean, median, mode and maximum and minimum scores. Meanwhile, the qualitative data analysis technique was carried out using the Miles and Huberman's technique. Furthermore, the work steps in this study consisted of identifying the need for takraw blocker media tools, designing robotic-based blocker media tool designs, consulting with robotic technicians, assembling tools, expert validation and small group trials.

## 3. Result

### 3.1 Eligibility of robotic-based block takraw technique skill tools

The robotic-based block takraw technique skill tool developed will go through hardware and software testing. The purpose of the test is to know the performance of the tool in accordance with the initial design so that results and comparisons are obtained from what was previously planned. As for testing the control of an important tool for training the smash ability of takraw athletes, it is not blocked by the opponent. The robotic-based block takraw technique skill tool developed is shown in Figure 1.

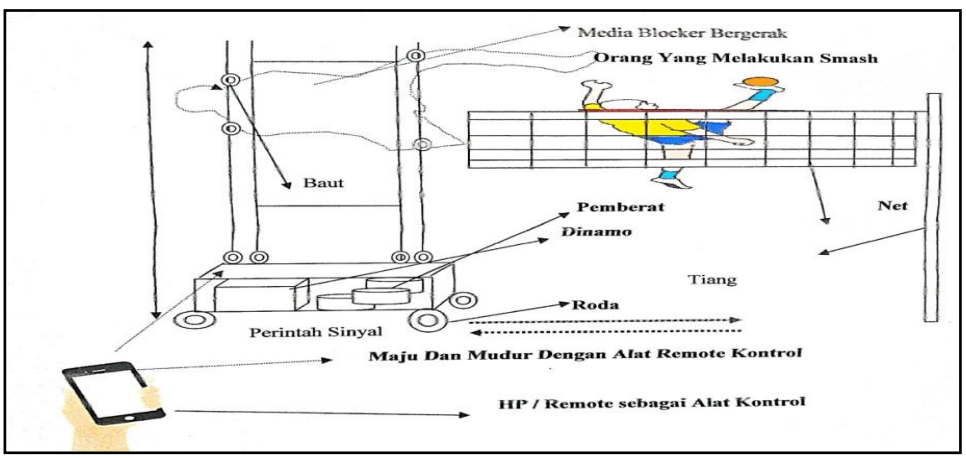


**Figure 1.** Robotic-Based Takraw Block Technique Skill Tool

The product developed in the form of a robotic-based takraw block technique skill tool must go through a validation test before being used. The purpose of the expert validation test is to see and

analyse the accuracy and suitability of the developed model. Expert validation was carried out in October 2021 at the Faculty of Sports Science by way of practice in the field, describing the tools and how they work in the field accompanied by filling out questionnaires that have been compiled by researchers. The results of expert validation that have been carried out can be observed in Table 5.

**Table 5.** *Expert Validation Results*

| Aspect | Sports measurement and evaluation test expert | | | Takraw expert | | | Media expert | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | % | Category | Mean | % | Category | Mean | % | Category |
| Physical | 3.20 | 80% | Good | 3.33 | 83.33% | Very Good | 3.44 | 86% | Very Good |
| Design | 3.40 | 85% | Very Good | 3.40 | 85% | Very Good | 3.14 | 78.57% | Good |
| Utility | 3.44 | 86% | Very Good | 3.20 | 80% | Good | 3.33 | 83.33% | Very Good |
| Total average | 3.34 | 83.5% | Very Good | 3.31 | 84.25% | Very Good | 3.30 | 82.5% | Very Good |

Table 5 shows the results of the validation of robot-based media blockers for takraw from three aspects, namely physical, design and usability. The robot-based media blocker tool for takraw sports had expert validation of sports measurement and evaluation tests, takraw expert validation and media expert validation. In the expert validation of sports measurement and evaluation tests, the physical aspect obtained an average of 3.20, with a percentage of 80, in the good category; the design aspect got an average of 3.40, with a percentage of 85, in the very good category; and the usability aspect got an average of 3.44, with a percentage of 86, in the very good category. The results of the expert validation of the measurement and evaluation tests of sports as a whole obtained a mean of 3.34, with a percentage of 83.5, in the very good category.

The results of the takraw expert validation on the physical aspect got an average of 3.33, with a percentage of 83.33, in the very good category. In the design aspect, the average is 3.40, with a percentage of 85, in the very good category. In the usability aspect, the average is 3.20, with a percentage of 80, in the good category. The results of the takraw expert validation as a whole get a total average of 3.31, with a percentage of 84.25, in the very good category.

The results of media expert validation on the physical aspect got an average of 3.44, with a percentage of 86, in the very good category. In the design aspect, the average is 3.14, with a percentage of 78.57, in the good category. In the usability aspect, the average is 3.33, with a percentage of 83.33, in the very good category. The results of the validation of media experts as a whole obtained an average total of 3.30, with a percentage of 82.5, in the very good category. Thus, all the validation scores are in the very good category.

### 3.2 Students'perceptions of the use of robotic-based block takraw technique skills

The robotic-based block takraw technique skill tool developed has been tested on students. Based on the test, the students' perceptions of the robotic-based block takraw technique skill tool were found. The results of the students' perceptionsshows the students' response or students' assessment after using the robotic-based takraw block technique skill tool. The description of students' perceptions of the use of the robotic-based takraw block technique skills tool is shown in Table 6.

**Table 6.** Description of Students' Perceptions of the Use of the Robotic-Based TakrawBlock Technique Skills Tool

| Interval | *f* | % | Category | Mean | Median | Mode | Min | Max |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 30.0–52.5 | 0 | 0% | Very Bad | 99.58 | 98 | 96 | 86 | 112 |
| 52.6–75.0 | 0 | 0% | Bad | | | | | |
| 75.1–97.5 | 7 | 28% | Good | | | | | |
| 97.6–120.00 | 18 | 72% | Very Good | | | | | |

Table 6 shows a description of the results of students' perceptions of the use of the robotic-based takraw block technique skills tool. It can be seen that 18 students, with a percentage of 72, are in the very good category. Then, 7 students, with a percentage of 28,are in the good category. The mean is 99.58, the median is 98, the mode is 96, the minimum score is 86 and the maximum score is 112. Based on the results obtained, we see that students have a very good perception of the use of robotic-based takraw block technique skills tool.

## 4. Discussion

This research developed a robotic-based block takraw technique skill tool. The tool developed is expected to be used as a supporting tool in training to improve the smash ability of takraw athletes. It must first go through hardware and software testing before being used. The purpose of the test is to determine the performance of the tool in accordance with the initial design so that the results and comparisons are obtained from what was previously planned.

The tool developed was checked for feasibility. The feasibility check was carried out on several aspects, namely 1) the type of battery [12 Volt/32 Ampere used by the car battery for reasons of length (the duration of the battery)], 2) the load power of the tool; 3) tool strength; 4) tool load; 5) remote tools; and 6) remote battery power. Then, the steps in using this tool are 100% and can be used directly before being tested. The implementation instructions are as follows:

1. Purpose: To test the feasibility of the media tool.
2. Equipment
    a. 1 soccer field
    b. 20 takraw balls
    c. Abo board
    d. Net takraw
    e. Pen
    f. Research questionnaire form
    g. Robotic-based media blocker tool
    h. Remote, Camera or Video.
3. The process of implementing the research instrument
    a. The team gathers athletes to get guidance from testees to listen to the steps for implementing the instrument's feasibility test.
    b. The media blocker is in field A on the right.
    c. The buoy next to field B stands in the middle as a float.
    d. The remoter behind field A is level with the robotic apparatus.

e. Validator next to the field.

f. At the time of execution of instructions from the director called the athlete to get ready.

g. One person smashes in field B along with the buoy.

h. The ball is baited by hand with a minimum height of 2 meters.

i. The remoter is ready to press the left and right side buttons by following the direction of the ball/smasher.

j. Expert validators immediately fill out the questionnaire that has been prepared.

k. Validator dari mahasiswa/pemain yang laki-laki mengisi angket bagi pelaksanaan yang perempuan.

l. Smash is done with at least 3–5 tries.

m. Video was taken for each testee when performing the smash skills.

4. The validator notices when the tool is used the following:

a. The device/media blocker is already connected to the remote.

b. The smash position is ready and a remote controller is ready to press the back and forth button by following the direction of the ball's speed.

c. The height of the blocker can be adjusted to the height of a smasher.

d. The robotic work system through the dynamo via the remote control is already live.

e. When the ball is running, the remote control immediately works with back and forth / left and right side is feasible.

f. Smashers who do must smash hard.

The robotic-based block takraw technique skills tool is tested for feasibility through validation. The purpose of the expert validation test is to see and analyse the accuracy and suitability of the developed model. So that it can measure what it should measure. The technique used in collecting data to test the validity of the construct was by interviewing and looking at the contents of the product developed so that researchers are able to reveal the widest possible data from the assessments of experts. The interview was accompanied by a working demonstration of the developed instrument model. The experts involved in this study consisted of three types of experts, namely experts on sports measurement and evaluation tests, takraw experts and media experts.

Expert validation is carried out based on three aspects, namely physical aspects, design aspects and usability aspects. The robotic-based block takraw technique skills tool had expert validation of sports measurement and evaluation tests, takraw expert validation and media expert validation. The results of the expert validation of the measurement and evaluation tests of sports as a whole obtained a mean of 3.34 with a percentage of 83.5 in the very good category. The results of the takraw expert validation as a whole obtained a total average of 3.31, with a percentage of 84.25, in the very good category. The results of the media expert validation as a whole obtained an average total of 3.30, with a percentage of 82.5, in the very good category. Thus, the robotic-based block takraw technique skills tool was declared very good and can be used.

In addition to the results of expert validation in the form of numerical data, interviews with experts were also obtained during the validation process. The results of the interviews became a source of

supporting data to develop robotic-based block takraw technique skills. Interviews were conducted with experts on sports measurement and evaluation tests, validation takraw experts and media experts. The measurement and evaluation test experts on behalf of the Republic of Indonesia stated that the image should be clarified with the grooves and distances; the description of the implementation of the test is clarified and for the implementation of the smasher it is better not to follow the tool; for the quality of the validator's questionnaire, the purpose and objectives of the items are further clarified; for further development using sensor tools; and led to the development of blocker and smasher test instruments.

The takraw expert on behalf of Z stated that he was assisted by a bouncer who was used to (his position) the ball being tossed at a minimum height of 2 m according to the ability of the smasher; the criteria for gender are male and female; on the smash item, it is tried once first by following the blocker tool; implementation for this test, preferably five times only; the location of the media blocker does not cross the net, the height of the block is parallel to the height of the person who is hitting the smasher (150–175 cm). Media experts on behalf of RY stated that the blocker board device is also made like robotics, speed blocker via sensor, propulsion should be further increased, media/box blockers should be reduced to make them lighter and faster, propulsion tools should be made even more sophisticated, android based remote control device and altitude adjustment using the remote too.

The robotic-based block takraw technique skill tool developed was then tested on students. With the aim of knowing students' perceptions of robotic-based takraw block technique skills tool. The results of student perceptions are student responses or student assessments after using robotic-based block takraw technique skills. The results of students' perceptions of the robotic-based takraw block technique skills tool obtained a mean of 99.58 with 18 students from a total of 25 students in the very good category. This shows that students have a very good perception of the use of robotic-based block takraw technique skills.

Many studies on the use of ICT in sports education have been carried out. This research is in line with research conducted by Yang (2020),who developed an artificial intelligence-based soccer training technology evaluation model where the results showed that the artificial intelligence-based soccer training technology evaluation model was more efficient to use. Then, Ikram et al. (2015) developed an IoT-based soccer surveillance system that embeds sensing devices (sensors and RFID) that can monitor the health of footballers and reduce health problems. Furthermore, this research is relevant to research by Astuti et al. (2022), who developed an interactive learning media for down and up passing techniques in volleyball games based on android technology using the MIT App Inventor where the product developed was declared very feasible to use. Not only that, Zhao and Liu (2021) also developed basketball shooting technology based on fusion motion capture acceleration sensors.

This research is in line with research conducted by Hermawan et al. (2019) which develops machine training (DBH 2MCS) to improve services for takraw athletes where the use of technology in takraw can be a means to support the development of athlete achievement. Furthermore, Nugroho and Sulaiman (2021) developed an android-based takraw learning media for students where students showed a very positive response to the takraw learning media application. However, there has been no previous research that has developed an integrated takraw sport with robotics. The purpose of this study was to develop and determine the feasibility of robotic-based block takraw technique skills, as well as to determine students' perceptions of the use of robotic-based block takraw technique skills.

The novelty of this research is the developmentof a robotic-based block takraw technique skill tool. Previous research discussed the development and use of technology in soccer, volleyball and basketball. The lack of technological development in takraw is one of the considerations of researchers in the innovations to be carried out, coupled with the absence of the use of robot-based technology in takraw. Therefore, it is necessary to develop a robotic-based block takraw technique skill tool. In addition, this study also analysed students' perceptions of the use of robotic-based block takraw technique skills. Student perceptions that arise due to the use of technology-based learning media tools can be used as a reference in the development of other learning media products. Furthermore, this research is also useful for knowing the development of robotic innovation in learning at universities.

This study implies that the robotic-based block takraw technique skill tool that was developed and declared to be suitable for use is one of the innovations in learning media. This study found that the development of robotic-based learning media was able to produce good student perceptions on the learning itself. The achievement of good student perceptions can be an indicator that the development of technology-based learning media is needed for learning today.

The limitation of this research is that the robotic-based block takraw technique skill tool developed was only tested on a small scale, namely students who are members of the student takraw activity unit, Padang State University. Trials on a large scale also need to be carried out to determine the feasibility of the product being developed more broadly to get maximum results. The researchers suggest conducting further research by testing the robotic-based block takraw technique skills tool on a large scale. Then, the researcher also suggested to conduct further research on the development of skill tools for other sports.

## 5. Conclusion

Based on the results of the study, it was found that the average scores of experts on sports measurement and evaluation tests, takraw experts and media experts were in the very good category. Thus, the results of the validation scores are in the very good category. The students gave very good perceptions about the use of the robotic-based takraw technique skills tool. Hence, the robot-based blocker technique skill tool can be used in improving the smash ability of takraw athletes. The limitation of this study is that the robotic-based block takraw technique skill tool was only tested on students who are members of the takraw student activity unit at Padang State University. Therefore, the suggestion that researcher puts forward is to implement the product more broadly to get maximum results.

## Acknowledgements

The author would like to thank the Dean of the Faculty of Sport Science, Universitas Negeri Padang, who allowed this research to be carried out. The researcher also expresses his deepest gratitude to the athletes who participated in the research conducted.

## References

Achmad, I. Z., Aminudin, R., Sumarsono, R. N., & Mahardika, B. (2019). Tingkat Ketrampilan Teknik Dasar Permainan Bola Voli Mahaisiwa PJKR Semester II Di Universitas Singaperbangsa Karawang Tahun Ajaran 2018/2019. *Jurnal Ilmiah PENJAS*, *5*(2), 48–60. http://ejournal.utp.ac.id/index.php/JIP/article/view/968

Aji, T., Sofyan, A., Humait, H., Dlis, F., & Mudian, D. (2021). Development Of Game Model Number Five Event In Sepak Takraw Branch In Central Java Players. *Turkish Journal of Computer and Mathematics Education*, *12*(6), 5262–5271. https://turcomat.org/index.php/turkbilmat/article/view/9341

Aldila, F. T., Darmaji, D., & Kurniawan, D. A. (2022). Analisis Respon Pengguna terhadap Penerapan Web-based Assessment pada Penilaian Sikap Siswa terhadap Mata Pelajaran IPA dan Nilai-nilai Pendidikan Karakter. *Edukatif: Jurnal Ilmu Pendidikan*, *4*(1), 1253–1262. https://doi.org/https://doi.org/10.31004/edukatif.v4i1.2091

Astalini, A., Darmaji, D., Kurniawan, W., Anwar, K., & Kurniawan, D. A. (2019). Effectiveness of Using E-Module and E-Assessment. *International Journal of Interactive Mobile Technologies*, *13*(9), 21–39. https://doi.org/https://doi.org/10.3991/ijim.v13i09.11016

Astra, I. K. B. (2017). Developing Instructional Material for Sepak Takraw Playing Technique Course Completed with Smart Audiovisual to Improve Competencies of the Students of Sport & Health Education Department Ganesha University of Education. *International Research Journal of Engineering, IT and Scientific Research*, *3*(4), 66–76. https://doi.org/10.21744/irjeis.v3i4.506

Astuti, Y., Zulbahri, Z., Erianti, E., Damrah, D., Pitnawati, P., & Rosmawati, R. (2022). Development of interactive learning media for low and overhead passing techniques in volleyball based on android technology using MIT app inventor. *Linguistics and Culture Review*, *6*, 213–220. https://doi.org/10.21744/lingcure.v6ns3.2132

Benotsmane, R., Dudás, L., & Kovács, G. (2018). Collaborating robots in Industry 4.0 conception. *IOP Conference Series: Materials Science and Engineering*, *448*(1), 0–9. https://doi.org/10.1088/1757-899X/448/1/012023

Bragança, S., Costa, E., Castellucci, I., & Arezes, P. M. (2019). A brief overview of the use of collaborative robots in industry 4.0: Human role and safety. *Studies in Systems, Decision and Control*, *202*, 641–650. https://doi.org/10.1007/978-3-030-14730-3_68

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer Science & Business Media.

Budoya, C. M., Kissaka, M. M., & Mtebe, J. S. (2019). Instructional Design Enabled Agile Method Using ADDIE Model and Feature Driven Development Method. *International Journal of Education and Development Using Information and Communication Technology (IJEDICT)*, *15*(1), 35–54. https://www.learntechlib.org/p/209737/

Darmaji, Astalini, Kurniawan, D. A., & Aldila, F. T. (2021). Students' Perceptions in the Use of Web-Based Character Assessment: A View from Gender Perspective. *Jurnal Pendidikan Progresif*, *11*(2), 362–383. https://doi.org/10.23960/jpp.v

Dianawati, I., Pramono, H., & Handayani, O. W. K. (2017). Pengembangan Alat Sensor Gerak Pada Garis Servis Double Event Dalam Permainan Sepaktakraw. *Journal of Physical Education and Sports*, *6*(3), 272–278. https://doi.org/10.15294/jpes.v6i3.14629

Eom, R., & Lee, Y. (2020). Mapping of Human Contact Areas for Application Field of Wearable Robots. *International Journal of Costume and Fashion*, *20*(2), 11–22. https://doi.org/10.7233/ijcf.2020.20.2.011

Fernandez, D. C., & Hollinger, G. A. (2017). Model Predictive Control for Underwater Robots in Ocean Waves. *IEEE Robotics and Automation Letters*, *2*(1), 88–95. https://doi.org/10.1109/LRA.2016.2531792

Ferrari, S. F., Borges, P. H., Teixeira, D., & Marques, P. G. (2018). Impact of verbal instruction and demonstration methods on self-efficacy and motor learning in inexperienced handball players. *Journal of Physical Education and Sport*, *18*(2), 816–820. https://doi.org/10.7752/jpes.2018.02120

Ferrero, G., Setty, K., Rickert, B., George, S., Rinehold, A., DeFrance, J., & Bartram, J. (2019). Capacity building and training approaches for water safety plans: A comprehensive literature review. *International Journal of Hygiene and Environmental Health*, *222*(4), 615–627. https://doi.org/10.1016/j.ijheh.2019.01.011

Gorecky, D., Khamis, M., & Mura, K. (2017). Introduction and establishment of virtual training in the factory of the future. *International Journal of Computer Integrated Manufacturing*, *30*(1), 182–190. https://doi.org/10.1080/0951192X.2015.1067918

Hakman, A., Vaskan, I., Kljus, O., Liasota, T., Palichuk, Y., & Yachniuk, M. (2018). Analysis of the acquisition of expertise and mastery of physical skills for performing techniques by young footballers. *Journal of Physical Education and Sport*, *18*(2), 1237–1242. https://doi.org/10.7752/jpes.2018.s2184

Hanafi, M. (2020). Pengembangan Tes Keterampilan Teknik Blocking dalam Permainan Sepak Takraw. *SATRIA Journal Of "Sports Athleticism in Teaching and Recreation on Interdisciplinary Analysis," 3*(2), 20–24. https://doi.org/https://doi.org/10.31597/satria.v3i2.505

Harsono. (2004). *Perencanaan Program Latihan*. Raja Grafindo.

Hasana, N. I., Sugihartono, T., & Raibowo, S. (2021). Pengembangan Model Media Pembelajaran Audio Visual Berbasis ICT Dalam Pembelajaran PJOK Pada Guru SD Negeri Se-Kecamatan Seluma. *SPORT GYMNASTICS : Jurnal Ilmiah Pendidikan Jasmani*, *2*(1), 60–69. https://doi.org/10.33369/gymnastics.v2i1.14911

Hermanto, Y. F. (2017). Pengaruh Latihan Bola Gantung Terhadap Kemampuan Servis Atas Pada Klub Sepaktakraw Yunior Panggul Kabupaten Trenggalek Tahun 2016. *Sportif*, *8.5.2017*. http://simki.unpkediri.ac.id/mahasiswa/file_artikel/2017/12.1.01.09.0191.pdf

Hermawan, D. B. (2020). Model Latihan Servis Tipuan (Trick Servce) Sepak Takraw Pemula. *Journal Ilmu Keolahragaan*, *3*(I), 51–72. http://dx.doi.org/10.31851/hon.v3i1.3737

Hermawan, D. B., Asmawi, M., & Tangkudung, J. (2019). Developing Machine Training (DBH 2MCS) to Improve Beginner Athlete Service in Sepak Takraw in Sumedang Regency. *Journal of Education, Health and Sport*, *9*(4), 42–54. https://doi.org/http://dx.doi.org/10.5281/zenodo.2617067

Hilliard, A. T. (2015). Global Blended Learning Practices For Teaching And Learning, Leadership, And Professional Development. *Journal of International Education Research (JIER)*, *11*(3), 179–188. https://doi.org/10.19030/jier.v11i3.9369

Ikram, M. A., Alshehri, M. D., & Hussain, F. K. (2015). Architecture of an IoT-based system for football supervision (IoT Football). *IEEE World Forum on Internet of Things, WF-IoT 2015 - Proceedings*, 69–74. https://doi.org/10.1109/WF-IoT.2015.7389029

Javier Lopez Frias, F., & Luis Pérez Triviño, J. (2016). Will robots ever play sports? *Sport, Ethics and Philosophy*, *10*(1), 67–82. https://doi.org/10.1080/17511321.2016.1166393

Jones, G. J., Edwards, M. B., Bocarro, J. N., Bunds, K. S., & Smith, J. W. (2017). An integrative review of sport-based youth development literature. *Sport in Society*, *20*(1), 161–179. https://doi.org/10.1080/17430437.2015.1124569

Kamide, H., Kawabe, K., Shigemi, S., & Arai, T. (2015). Anshin as a concept of subjective well-being between humans and robots in Japan. *Advanced Robotics*, *29*(24), 1624–1636. https://doi.org/10.1080/01691864.2015.1079503

Kosni, N. A., Abdullah, M. R., Juahir, H., Maliki, A. B. H. M., & Musa, R. M. (2018). Establishing reliability of performance indicator of sepak takraw using notational analysis. *Journal of Fundamental and Applied Sciences*, *9*(2S), 1. https://doi.org/10.4314/jfas.v9i2s.1

Kovacic, M. (2018). The making of national robot history in Japan: monozukuri, enculturation and cultural lineage of robots. *Critical Asian Studies*, *50*(4), 572–590. https://doi.org/10.1080/14672715.2018.1512003

Kusuma, L. S. W. (2019). Penerapan Metode Blocked Practice Dan Media Footwork Berbasis Teknologi Dalam Upaya Meningkatkan Keterampilan Bermain Bulutangkis. *JUPE : Jurnal Pendidikan Mandala*, *4*(4), 193–202. https://doi.org/10.36312/jupe.v4i4.932

Maksymchuk, B., Gurevych, R., Matviichuk, T., Surovov, O., Stepanchenko, N., Opushko, N., Sitovskyi, A., Kosynskyi, E., Bogdanyuk, A., Vakoliuk, A., Solovyov, V., & Maksymchuk, I. (2020). Training Future Teachers to Organize School Sport. *Revista Romaneasca Pentru Educatie Multidimensionala*, *12*(4), 310–327. https://doi.org/10.18662/rrem/12.4/347

Maseleno, A., Hasan, M. M., Muslihudin, M., & Susilowati, T. (2016). Finding kicking range of sepak takraw game: Fuzzy logic and Dempster-Shafer theory approach. *Indonesian Journal of Electrical Engineering and Computer Science*, *2*(1), 187–193. https://doi.org/10.11591/ijeecs.v2.i1.pp187-193

Melesse, S., & Mekonnen, D. (2020). The Contribution of Placement School Experiences to Prospective Teachers' Multicultural Competence Development: Ethiopian Secondary Schools in Focus. *Journal of Education and Learning (EduLearn)*, *14*(1), 15–27. https://doi.org/https://doi.org/10.11591/edulearn.v14i1.14272

Muhyi, M., Hanafi, M., Sukmana, A. A., Utamayasa, I. G. D., & Prastyana, B. R. (2021). The Effectiveness of Krwanjang Game Implementation on Sepak Sila's Skills in Sepak Takraw Game at Surabaya Sepak Takraw Academy. *Jurnal SPORTIF: Jurnal Penelitian Pembelajaran*, *7*(3), 367–377. https://doi.org/https://doi.org/10.29407/js_unpgri.v7i3.16148

Nata, Y. R. & A. R. (2021). Pengembangan Model Latihan Teknik Dasar Sepak Kura Berbantuan Alat dalam Permainan Sepak Takraw Bagi Mahasiswa Program Studi PJKR STKIP Citra Bakti. *Imedtech*, *4*(1), 6. https://doi.org/http://dx.doi.org/10.38048/imedtech.v5i2.245

Nomura, T., Syrdal, D. S., & Dautenhahn, K. (2015). Differences on social acceptance of humanoid robots between Japan and the UK. *AISB Convention*.

Nugroho, B. W., & Sulaiman. (2021). Pengembangan Media Pembelajaran Sepaktakraw Berbasis Android Bagi Peserta Didik Kelas X SMA Negeri 1 Demak. *Indonesian Journal for Physical Education and Sport*, *2*(2), 504–509. https://doi.org/https://doi.org/10.15294/inapes.v2i2.45928

Permana, M., Kusdinar, A. B., & Pri, G. (2021). Penerapan Metode Profile Matching untuk Penentuan Pemain Ideal Peserta O2Sn Cabang Olahraga. *Jurnal Teknik Informatika Kaputama*, *5*(2), 359–369. https://jurnal.kaputama.ac.id/index.php/JTIK/article/view/634

Pichardo, A. W., Oliver, J. L., Harrison, C. B., Maulder, P. S., Lloyd, R. S., & Kandoi, R. (2021). Effects of Combined Resistance Training and Weightlifting on Injury Risk Factors and Resistance Training Skill of Adolescent Males. *Journal of Strength and Conditioning Research*, *35*(12), 3370–3377. https://doi.org/10.1519/JSC.0000000000003341

Padli., Kiram, Y., Syahara, S., Lesmana, H. S. (2020). Combined Effects of Weight Training and Aerobic Exercise Accompanied by Normal and Low-Calorie Diets on Fat Percentage of Young Women. *International Journal of Human Movement and Sports Sciences, 8*(5), 283 - 291

Padli, P., Mardela, R., & Yendrizal, Y. (2022). Improving students' cricket hitting skills using digital test. *Cypriot Journal of Educational Sciences*, *17*(5), 1495-1507.

Padli, P., Kiram, Y., Arifianto, I., Komaini, A., Setiawan, Y., & Mairifendi, M. (2022). The effect of academic stress and learning motivation of pre-service teachers in aerobics. *Cypriot Journal of Educational Sciences*, *17*(4), 1066-1076.

Padli, P., Kiram, Y., Arifianto, I., Setiawan, Y., Haryanto, J., & Lesmana, H. S. (2022). The effect of online-based assignment responses and student creativity in PJOK during pandemic in rural and urban area. *Jurnal Keolahragaan*, *10*(1), 127-136.

Pratama, D. S., Rahayu, T., & Kusuma, D. W. Y. (2017). Pengaruh metode latihan dan panjang tungkai terhadap hasil servis pada atlet sepaktakraw kabupaten demak. *Journal of Physical Education and Sports*, *6*(3), 236–240. https://doi.org/10.15294/jpes.v6i3.20586

Purwanto, D. (2017). Development of Playing Skills Sepak Takraw Exercises Models Based on Interactive Multimedia. *Jipes - Journal of Indonesian Physical Education and Sport*, *3*(1), 33. https://doi.org/10.21009/jipes.031.05

Raj, M., & Seamans, R. (2019). Primer on artificial intelligence and robotics. *Journal of Organization Design*, *8*(1). https://doi.org/10.1186/s41469-019-0050-0

Russell, S., Jenkins, D., Smith, M., Halson, S., & Kelly, V. (2019). The application of mental fatigue research to elite team sport performance: New perspectives. *Journal of Science and Medicine in Sport*, *22*(6), 723–728. https://doi.org/10.1016/j.jsams.2018.12.008

Sahabuddin. (2020). Pengaruh Latihan Smash Bola Gantung Dan Bola Lambung Terhadap Kemampuan Smash Dalam Permainan Sepaktakraw. *SPORTIVE: Journal Of Physical Education, Sport and Recreation*, *3*(2), 105. https://doi.org/10.26858/sportive.v3i2.17003

Sallis, J. F., Bull, F., Guthold, R., Heath, G. W., Inoue, S., Kelly, P., Oyeyemi, A. L., Perez, L. G., Richards, J., & Hallal, P. C. (2016). Progress in physical activity over the Olympic quadrennium. *The Lancet*, *388*(10051), 1325–1336. https://doi.org/10.1016/S0140-6736(16)30581-5

Siau, K., & Wang, W. (2018). Building Trust in Artificial Intelligence, Machine Learning, and Robotics. *Cutter Business Technology Journal*, *31*(2), 47–53. https://www.cutter.com/article/building-trust-artificial-intelligence-machine-learning-and-robotics-498981

Stapa, M. A., & Mohammad, N. (2019). The Use of Addie Model for Designing Blended Learning Application at Vocational Colleges in Malaysia. *Asia-Pacific Journal of Information Technology & Multimedia*, *8*(1), 49–62. https://doi.org/10.17576/apjitm-2019-0801-05

Syukur, A., & Soniawan, V. (2015). The Effects of Training Methods and Achievement Motivation Toward of Football Passing Skills. *Jipes - Journal of Indonesian Physical Education and Sport*, *1*(2), 73. https://doi.org/10.21009/jies.012.07

Tegeh, I. M., Parwata, I. G. L. A., & Ostaviani, B. G. (2020). The Observing Learning Activity Assisted by Concrete Media Improves Student's Conceptual Knowledge. *JPI (Jurnal Pendidikan Indonesia)*, *9*(2), 182–192. https://doi.org/http://dx.doi.org/10.23887/jpi-undiksha.v9i2.25206

Torres-Ronda, L., & Schelling, X. (2017). Critical process for the implementation of technology in sport organizations. *Strength and Conditioning Journal*, *39*(6), 54–59. https://doi.org/10.1519/SSC.0000000000000339

Umar, U., Alnedral, A., Padli, P., & Mardesia, P. (2022). Effectiveness of sports biomechanics module based on literacy skills to improve student concept understanding. *Jurnal Keolahragaan*, *10*(2), 183-195.

Udomtaku, K., & Konharn, K. (2020). Energy expenditure and movement activity analysis of sepaktakraw players in the Thailand league. *Journal of Exercise Science and Fitness*, *18*(3), 136–141. https://doi.org/10.1016/j.jesf.2020.04.001

Vrontis, D., Christofi, M., Pereira, V., Tarba, S., Makrides, A., & Trichina, E. (2022). Artificial intelligence, robotics, advanced technologies and human resource management: a systematic review. *International Journal of Human Resource Management*, *33*(6), 1237–1266. https://doi.org/10.1080/09585192.2020.1871398

Wicaksono, L., & Utama, D. D. P. (2020). Pemanfaatan Media Pembelajaran Berbasis Ict Oleh Guru Penjas Kota Bandar Lampung. *Jurnal Kejaora (Kesehatan Jasmani Dan Olah Raga)*, *5*(1), 41–49. https://doi.org/10.36526/kejaora.v5i1.846

Wijayati, Erni , Soegiyanto, S. R. (2015). Evaluasi Program Pembinaan Olahraga Sepaktakraw Pengurus Persatuan Sepaktakraw Indonesia Kabupaten Jepara. *Journal of Physical Education and Sports*, *4*(1). https://doi.org/10.15294/jpes.v4i1.6914

Xiao, X., Hedman, J., Tan, F., Tan, C., & Clemmeson, T. (2017). Sports Digitalization: A Review and A Research Agenda. *Proceedings of theThirty Eighth International Conference on Information Systems*, 6–10. https://research.utwente.nl/en/publications/sports-digitalization-an-overview-and-a-research-agenda

Yang, Y. (2020). Evaluation Model of Soccer Training Technology Based on Artificial Intelligence. *Journal of Physics: Conference Series*, *1648*(4), 0–8. https://doi.org/10.1088/1742-6596/1648/4/042085

Zhao, B., & Liu, S. (2021). Basketball shooting technology based on acceleration sensor fusion motion capture

technology. *Eurasip Journal on Advances in Signal Processing*, *2021*(1). https://doi.org/10.1186/s13634-021-00731-9

Zulkifli, Asmawi, M., Hanif, A. S., & Bon, A. T. (2019). Model Teaching Style and Motor Ability on Sport Science Student Achievement Learning Outcome Sepak Takraw. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 1417–1423. http://ieomsociety.org/toronto2019/papers/493.pdf