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Ethnomathematics and Ethnosport in Traditional Games for Thematic Learning

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Abstract. *Egrang* is one of the traditional games in Indonesia which is known in various regions with the same or different names. As part of a culture, traditional games contain a variety of knowledge that can be implemented in school learning. Generally, the implementation is done for one subject only. This study aims to explore *egrang*, identify ethnomathematics and ethnosports contained in it, and implement ethnomathematics and ethnosport in elementary school thematic learning. Research respondents are cultural figures in Banyuwangi and Surabaya, teachers, and third-grade students in an elementary school in Banyuwangi. The research uses ethnographic-based qualitative methods. Data were collected by observation, interviews, questionnaires, and tests. Data analysis was carried out qualitatively and quantitatively. The results showed that there were ethnomathematics and ethnosport in *egrang*. The sorting of ethnomathematics and ethnosports that is implemented in learning shows that learning in elementary school grade 3 with thematic concepts provides an average value learning implementation of 4.37 which includes high criteria, and the value of completion of exercise is 87 which includes high criteria. Research can be developed using other ethnomathematics and ethnosports in thematic learning in different classes or levels.

INTRODUCTION

Traditional games are one of the cultures that are still widely practiced in various countries, including Indonesia. Traditional games are fun activities that contain the main intrinsic motivational factors to attract students' attention and make them persistent and enthusiastic about the activity [1]. Traditional games are games that are historically based on local conditions and culture [2]. Traditional games are typical games with certain cultural backgrounds that have various forms and variationsand tend to use tools or objects in the surrounding environment without having to buy them so they require high imagination and creativity [3].

Games are one of entertainment for children and adults that can teach independence and contain meaningful learning [4]. By playing, the child can adapt to the world; acquire developments in language and concepts; can

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express themselves, adapt, and make contact with the environment [2], and noble values and moral messages such as the value of togetherness, honesty, skills, solidarity, courage, responsibility, encouragement to excel, and obedience to rules [3][5], taught to the next generation.

One of the traditional games that are well-known inIndonesia is *egrang*. *Egrang* is a traditional game that uses a pair of bamboo whose diameter is the same as an adult's arm, which is relatively straight and old, each bamboo is about 1,5 – 3 meters long, 20 – 30 cm from one of the bamboo bases is perforated to insert pieces of bamboo with a width of 20 cm as a footrest [6], as shown in Fig. 1.

FIGURE 1. *Egrang* Game (Documentation from KKD Surabaya).

Egrang can be done with the rules of a race or fast race, as well as knocking each other down [7]. *Egrang* provides benefits for developing and controlling children's motor skills; increasing the strength of the muscles of the legs, feet, abdomen, arms, and hands; training balance and flexibility [8]; training agility and accuracy; improving eye, hand, and foot coordination [9]. In this case, *egrang* can also be seen as a part of traditional sports. In addition, *egrang* also contain mathematical concepts such as counting, triangles, unit of length, Pythagoras, and linear inequalities of one variable [10]. From these opinions, it can be seen that *egrang* contains concepts of knowledge, including mathematics and sports. However, this requires further identification.

The concept of mathematics-related knowledge in culture is known as ethnomathematics. While the concept related to sports in culture is known as ethnosport. D'Ambrosio describes ethnomathematics as "the mathematics practiced by cultural groups, such as urban and rural communities, groups of workers, professional classes, children in a given age group, indigenous societies, and so many other groups that are identified by the objectives and traditions common to these groups" [11]. While ethnosport can be understood as various forms of physical activity found in traditional or national sports [12]. Thus, *egrang* can be used as a medium of learning, especially in mathematics and sports.

Traditional games can be used as innovative learning media if they are applied and used appropriately, systematically, and practically [5], and serve as learning tools in various subjects according to their characteristics to arouse students' motivation and interest in achieving learning objectives [13]. Traditional games can also be used to visualize abstract topics, increase student motivation in learning, generate critical thinking skills, increase information and collaborative activities, create an experiential learning environment and improve student achievement [14].

Introducing traditional games in learning is considered to increase motivation in all learning designs, such as attention and active participation of students in game-based learning activities; the relevance of game activities that are already known to students with learning objectives; provide a comfortable learning environment where students have control over the action required; as well as giving a sense of satisfaction because they can carry out activities that contain equality, unity, clarity, and justice that can be used effectively during learning [1]. This explanation makes it important to conduct research, including finding out learning concepts (especially mathematics and sports) in *egrang*, as well as knowing the implementation of *egrang* in elementary school thematic learning. This is related to the implementation of the "*merdeka*" curriculum in Indonesia which needs to be developed with the principle of diversification according to educational units, regional potential, and students [15]. In this case, *egrang* is part of the regional potential.

In addition, it is mentioned in the learning outcomes of the "*merdeka*" curriculum that one of the goals of learning mathematics is to equip students with the ability to relate between concepts in learning mathematics,

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between mathematical concepts across subjects, and between mathematical concepts and real-life [16]. For this reason, ethnomathematics and ethnosport of *egrang* are needed as a bridge to connect mathematical concepts with other subjects and real life.

Previous research has shown that the integration of traditional games in primary schools can improve learning outcomes, interest, involvement of children, and interactions with teachers and classmates [14]. Another study in an elementary school in Bali showed that the implementation of a scientific approach to learning to communicate based on traditional games had a positive effect on the achievement of grade 4 students [17]. Research on the use of traditional games in mathematics learning shows that the concept of numbers in traditional games is an interesting aspect that is useful for children to deal with various situations related to numbers [18].

Various studies have shown that ethnomathematics identification has been carried out in playing *egrang* [10] and the benefits of playing on *egrang* to strengthen the ability to move the human body [8][9]. However, no one has conducted studies on ethnomathematics and ethnosport together and applied them in learning. So that the results of this research are expected to become learning innovations, especially in the implementation of the *"merdeka"* curriculum, as well as being the basis for subsequent studies in implementing ethnomathematics and ethnosport into thematic learning. Based on the descriptions of various theories above, this research was conducted to identify ethnomathematics and ethnosport in *egrang* and then integrate them into traditional game-themed learning that combines mathematics and sports lessons.

METHOD

This research was conducted in two stages, including the ethnographic stage to identify ethnomathematics and ethnosport in *egrang*, as well as the experimental stage to determine the process and results of thematic learning that includes ethnomathematics and ethnosport in *egrang*. The ethnographic stage is carried out with 12 steps adopted by Spradley [19]. The results of the ethnographic stage are used as material for compiling learning tools for use in the learning experiment stage. The research flow is shown in Fig. 2.

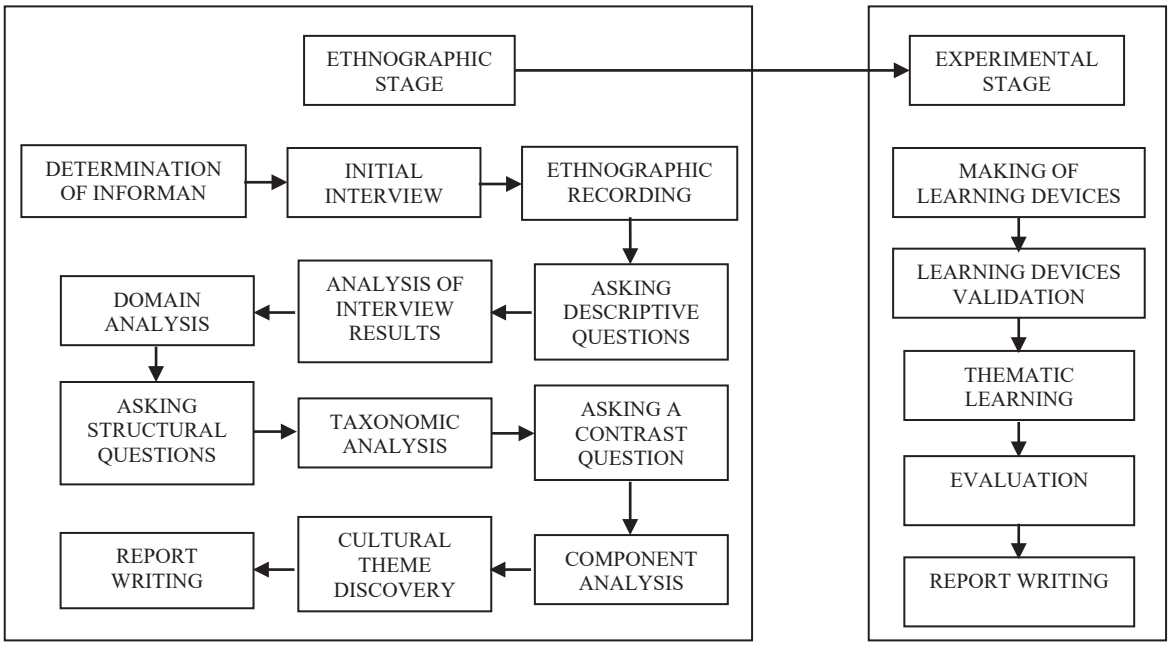

FIGURE 2. Research flow.

The research was conducted from November 2021 to July 2022. In ethnographic research, two informants are selected according to their background, and knowledge can explain and can practice *egrang*. The informants came from the traditional school community in Banyuwangi and the traditional game community in Surabaya. While the

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learning respondents are one elementary school teacher, one sports teacher, and 19 grade 3 students in an elementary school in Banyuwangi.

Data was collected through in-depth interviews, participatory observation, and cultural documentation during the ethnographic stage and was carried out with two selected informants. Meanwhile, in the experimental stage, data collection was carried out with learning observations and tests. In-depth interviews were conducted with 2 informants using interview guidelines. The participatory observation was carried out based on the observation sheet. While the cultural documentation was collected in the form of photos, videos, and interview transcripts. The data that has been collected is then analyzed together with the process of collecting data and writing research findings according to the steps in the ethnographic method [20][21]. Indicators for determining ethnomathematics and ethnosport are based on basic and secondary education competencies [22].

The data at the ethnographic stage becomes the material for making *egrang*-based thematic learning designs by combining ethnomathematics and ethnosport. The learning design is realized in the form of lesson plans and student worksheets containing tests. During the learning process, the implementation of the learning design was observed. And at the end of the lesson, students are asked to complete a test on a worksheet. The data obtained at the experimental stage were analyzed quantitatively. Thematic learning based on *egrang* by combining ethnomathematics and ethnosport is effective if the results of observations show a minimum average of high criteria (according to Table 1) and the results of student test completion show a minimum average of high criteria (according to Table 2) [23].

TABLE 1. Criteria for observation of learning implementation results.

Interval	Learning Implementation Criteria
$1 \leq \overline{X} < 2$	Very low
$2 \leq \overline{X} < 3$	Low
$3 \leq \overline{X} < 4$	Currently
$4 \leq \overline{X} < 5$	High
$\overline{X} = 5$	Very high

Adapted from[23].

TABLE 2. Criteria for student test completion results.

Interval	Test Completion Results Criteria
$0 \leq \overline{X} < 40$	Very low
$40 \leq \overline{X} < 60$	Low
$60 \leq \overline{X} < 75$	Currently
$75 \leq \overline{X} < 90$	High
$90 \leq \overline{X} \leq 100$	Very high

Adapted from[23].

RESULTS AND DISCUSSION

Egrang Exploration

The ethnographic stage in this study was carried out at the Sekolah Adat Kampoeng Batara (SAKB) Banyuwangi and Komunitas Kampung Dolanan (KKD) Surabaya. SAKB is one of the traditional schools in Banyuwangi which was established to teach culture to the next generation. While KKD is a cultural conservation community in Surabaya that actively teaches traditional games. The first informant is the founder and teacher at SAKB Banyuwangi. The second informant is the founder and executor of the KKD Surabaya. The results of the *egrang* exploration show that the main material for the *egrang* is bamboo, *apus*or*watu*, or other types that are easy to find.

Generally, a pair of *egrang* requires about 4 meters of bamboo or as long as needed. Each stem consists of six to seven bamboo segments, each of which is about 25 to 35 cm long. The length of the handle of the *egrang* is adjusted to the player's height but must be longer. The footrest part of the whole bamboo requires 25 to 30 cm long bamboo with a diameter more than the diameter of the *egrang* handle bamboo. The side of the bamboo is perforated as large

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as the diameter of the bamboo handle, then the bamboo part of the handle is inserted into another bamboo which is used as a foothold.

If you want to use a piece of bamboo as a footrest, then the bamboo part of the handle must first be perforated the size of the width of the footrest. After that, the bamboo split is inserted into the hole and then nailed. In addition, a supporting part using bamboo with a length as needed is added, as shown in Fig. 3(a) on the right. Supports function as holding bamboo steps and bamboo handles. All sizes are adapted to existing materials and players' needs.

(a) (b)

FIGURE 3. *Egrang* (documentation from (a) SAKB Banyuwangi and (b) KKD Surabaya).

In Banyuwangi, *egrang* can be played with various game modifications, such as fast or slow races, *egrang pecut*, and *egrang* soccer. Whereas in Surabaya, generally *egrang* is only used for agility games or *egrang* fighting. Fast or slow fighting games are carried out to get a winner among several players, as shown in Fig. 4(a). The player is declared the winner in the fast race if he reaches the deadline first. Meanwhile, the player is declared the winner in the slow fight if he reaches the end of the predetermined limit.

(a) (b)

FIGURE 4. (a) *Egrang* Fight (Documentation KKD Surabaya) and (b) *Egrang Pecut* (Documentation SAKB Banyuwangi).

Egrang pecut is carried out between two groups of players, as shown in Fig. 4(b). The number of members of each group is adjusted to the number of players available and the availability of game tools. A first group is a group of *egrang* players. While the second group is the holder of the *pecut* (whip) or vice versa. The group of *egrang* players must be able to maintain their position on the *egrang* while continuing to walk or dance. The group of *pecut* holders must try to bring down the *egrang* players by whipping the bottom of the *egrang*. *Pecut* is usually made from interwoven banana leaf stems that have dried. *Pecut* should not hit the player's bodybut on the *egrang* tool. If all *egrang* players can be dropped from their tools, then the group is declared defeated. Then the two groups swap roles.

Egrang soccer is a game that is modified from the usual football game, but players do it on the *egrang*. This game can be played individually one on one (as in Fig. 5) or in groups. The game begins by making the boundaries of the playing area and marking the goal of each player/group. The size of the boundaries of the playing area and the

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goal is made by agreement. Next, the two players/groups make a *suit* to determine the player who kicks the ball first. The ball is made of a medium-sized bamboo basket with a side length of approximately 20 cm.

FIGURE 5. *Egrang* soccer.

The suit is a one-on-one player draw using the three-finger rule, namely the thumb, index finger, and little finger. The rules of the draw are that the thumb wins against the index finger, the index finger wins against the little finger, and the little finger wins against the thumb. The player/group of players must try to get the ball into the opponent's goal as much as possible in the allotted time. Players/groups of players are declared to win if they get the most points (goals) until the time limit has been determined.

Ethnomathematics and Ethnosport in*Egrang*

Based on the exploration results, it can be determined that the domains in the *egrang* game processes and game tools. Furthermore, the domain becomes the basis for taxonomic analysis to find cultural themes in the context of ethnomathematics and ethnosports. The taxonomic analysis is based on the basic competencies of mathematics and sports subjects for primary and secondary education [22].

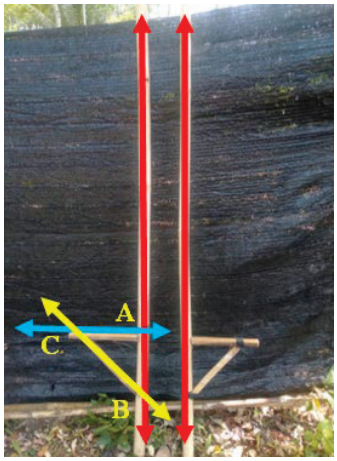

FIGURE 6. A Pair of*Egrang*tools.

The *egrang* uses a tool made of tubular bamboo that contains six to seven bamboo segments. Bamboo contains the concept of a tube because it is a shape that has a congruent base and is covered in the form of a circle [24]. If each bamboo-segment is about 35 cm long, then the *egrang* is about 2 to 2.5 meters long (as shown by the red line in Fig. 6). While the cross-section of bamboo is circular with a diameter of 5 to 7 cm. A circle is a collection of points that are equidistant from a given point [25]. This condition shows the concept of measurement with non-standard units and circles. Measuring is an activity to compare the measured quantity with similar quantities used as units [26]. It is further explained that non-standard units are units that are not designated as scientific units of measurement.

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The length of the bamboo used to make the *egrang* is adjusted to the player's height and generally must be longer than the player's height. This condition shows the concept of measurement.The installation of the footing causes the *egrang* handles, footings, and supports to form a right triangle (as shown by the red, blue, and yellow lines in Fig. 6).This shape is called a right triangle because one of the angles is equal to 90 [27], which is between the *egrang* handle and the footing.

Figure 6 shows the two *egrang* handles (red lines) showing the relationship of two parallel lines because if they are positioned in a plot the two lines do not intersect [28]. Each *egrang* handle is connected with a footing and support. The *egrang* handle (depicted as a red line) and the footing (depicted as a blue line) intersect at point A. The handle and support (depicted as a yellow line) intersect at point B. While the footing and support intersect at point C. The concept of the intersecting line occurs because the two lines have exactly one common point [28].

The *egrang* handles, steps, and supports form triangle ABC which contains right angles at vertices A and acute angles at vertices B and C. The concept of an acute angle is known because the measure of the angle is less than 90 [28]. As a result, on the *egrang*, it is also known that there is a Pythagorean concept, which is in a triangle if the square of one side length is equal to the sum of the squares of the lengths of the other sides, then the triangle is a right triangle [29].

The game of fast fighting or slow *egrang* competition can be done by two or more players. All players standing in the starting position form a line in their order. In this position, the process of counting the *egrang* players can be carried out. Numbering is the activity of determining the number of objects or activities that are carried out by mentioning a series of number names starting from one, and pointing to a different object or activity when the name of each number is mentioned [30].

Players stand in a line (form a straight line). While the *egrang* are positioned parallel to each other and perpendicular to the ground. The red line in Fig. 7(a) indicates the parallel position of the *egrang*, while the yellow markings indicate the perpendicular position or at right angles to the ground.

(a) (b) (c)

FIGURE 7. (a) Starting position, (b) prep position and (c) walking position.

The player follows the initial signal for preparation by raising one foot to the *egrang*. In this position, the *egrang* and the ground form an obtuse angle, as shown in the green markings in Fig. 7(b). An obtuse angle is an angle whose measure is between 90 and 180 [28]. The player starts walking on cue. To maintain balance during walking, players position one *egrang* at an acute angle (blue mark) with the ground and the other *egrang* at an obtuse angle (green marked) with the ground, as in Fig. 7(c).

The process of recording the time it takes players to enter the game's end limit includes the concept of measurement. Data on the sequence of players entering the deadline and the time taken from the initial limit to the final limit can be used as a data collection process in statistical concepts. Data is several pieces of information that can provide an overview of a situation or problem [31]. Determining the order of the players is done with the concept of comparing the time taken between players.

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FIGURE 8. Whip group attempts to bring down *Egrang* player.

In *egrang pecut* grouping is carried out between *egrang* players and whippers.The grouping shows the concept of a set, which is a collection of objects that can be clearly defined [25]. Each member of the whipping group must try to knock down a nearby *egrang* player by whipping the bottom of the *egrang*. The opportunity for each member of the whipped group to knock down every member of the *egrang* player shows the concept of relationship, as shown by the red and yellow arrows in Fig. 8 above. A relation occurs if there are members of the first set that are paired with members of the second set [25]. If all *egrang* players can be dropped until they are unable to climb back up to the *egrang* again, then the group of *egrang* players is declared defeated. The frequency with which players fall off their *egrang* can become data collected in statistical concepts.

Egrang football which is done in groups contains the concept of a set in the process of group formation. The boundaries of the game area are generally made by agreement in the form of a rectangle with the size according to the conditions of the game area. The game area is rectangular because it is a flat shape that has two pairs of opposite sides of equal length and four right angles [27]. On opposite sides of the playing area, a goal boundary is made for each player/group, as shown in Fig.9.

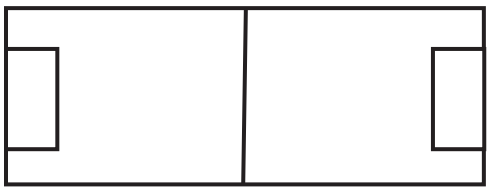

FIGURE 9. *Egrang*soccer game area.

Both players/groups start the game with a *suit* to determine the player who kicks the ball first. The *suit* rule contains the concept of probability, which is a measure of the certainty of the occurrence of an event [24]. Many goals scored by players can be recorded as data that is part of the statistical concept. The game is played at the agreed time. So there is a concept of measuring time in *egrang* football.While the bamboo basket, as shown in Fig. 10, used as a ball contains the concept of a rectangular prism, which is a polyhedron that has two pairs of parallel sides and all other sides are parallel to a line that cuts the loaders of the two parallel sides[28].

FIGURE 10. Basket used as ball.

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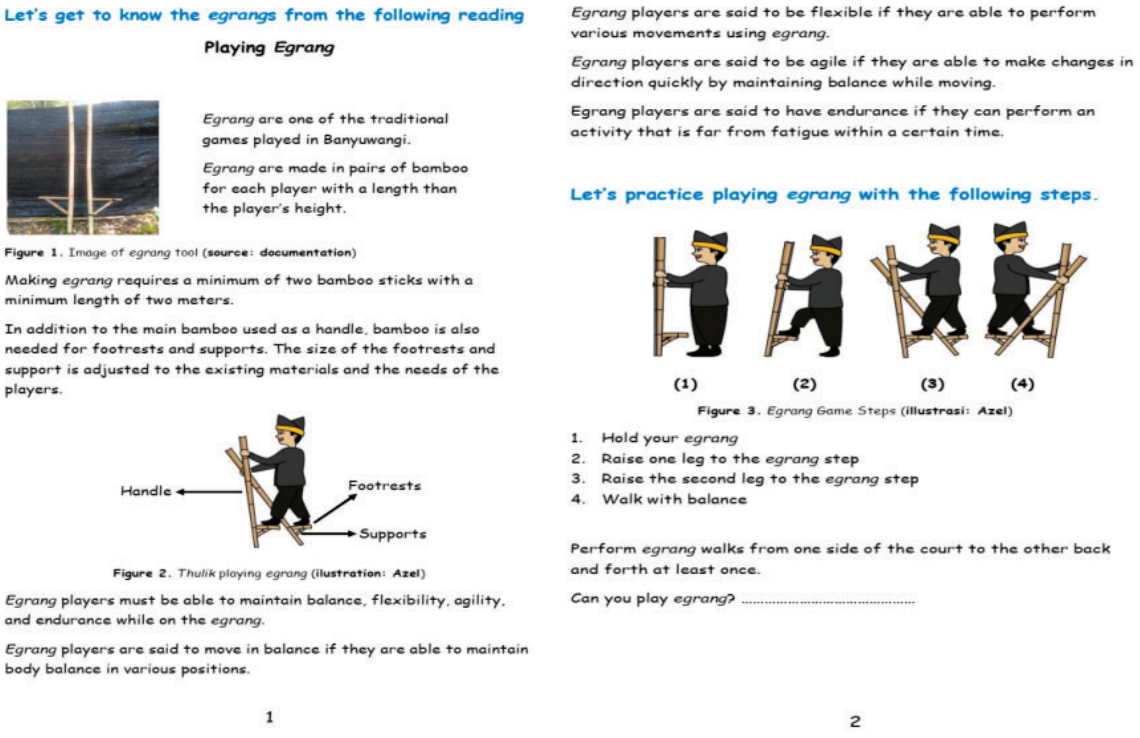
Egrang players move on *egrang* to walk in all directions or move in one particular place. This shows the concept of locomotor motion and non-locomotor motion. Locomotor is the movement of the body from one place to another, such as: walking, running, tiptoeing, jumping, rolling, galloping, crawling, and climbing [32][33]. On the other hand, movements that do not indicate displacement are known as non-locomotor.

In certain games such as *egrang* football, players also need to develop their movements when facing the ball. The development of this movement involves the activity of the feet and hands that move the *egrang*. This shows the existence of manipulative motion. Manipulative is a movement that is developed when dealing with various objects, involving body parts such as hands, feet, and head [32][34].

In locomotor, non-locomotor, and manipulative movements performed, players must also be able to maintain balance, flexibility, agility, and endurance to maintain their position on the *egrang*. Balance is the ability to maintain body balance in various positions, while flexibility is the ability to perform exercises with a large or wide amplitude of movement [35]. Agility is the ability to change direction quickly by maintaining balance while moving [36]. Endurance is the time that shows the length of time a person can perform an activity that is far from fatigue [37].

Combining Ethnomathematics and Ethnosport in *Egrang*-Based Thematic Learning

Egrang-based thematic learning is implemented for 3rd graders in an elementary school in Banyuwangi. Respondents were one elementary school teacher, one sports teacher, and 19 grade 3 students. Learning was carried out in one meeting. The subjects chosen to be integrated into the thematic concepts are mathematics and sports.


Let's get to know the *egrangs* from the following reading

Playing *Egrang*

Egrang are one of the traditional games played in Banyuwangi.

Egrang are made in pairs of bamboo for each player with a length than the player's height.

Figure 1. Image of *egrang* tool (**source: documentation**)

Making *egrang* requires a minimum of two bamboo sticks with a minimum length of two meters.

In addition to the main bamboo used as a handle, bamboo is also needed for footrests and supports. The size of the footrests and support is adjusted to the existing materials and the needs of the players.

Figure 2. *Thulik* playing *egrang* (**ilustration: Azel**)

Egrang players must be able to maintain balance, flexibility, agility, and endurance while on the *egrang*.

Egrang players are said to move in balance if they are able to maintain body balance in various positions.

1

Egrang players are said to be flexible if they are able to perform various movements using *egrang*.

Egrang players are said to be agile if they are able to make changes in direction quickly by maintaining balance while moving.

Egrang players are said to have endurance if they can perform an activity that is far from fatigue within a certain time.

Let's practice playing *egrang* with the following steps.

Figure 3. *Egrang* Game Steps (**illustrasi: Azel**)

1. Hold your *egrang*
2. Raise one leg to the *egrang* step
3. Raise the second leg to the *egrang* step
4. Walk with balance

Perform *egrang* walks from one side of the court to the other back and forth at least once.

Can you play *egrang*? .....

2

FIGURE 11. Readings about *Egrang*and how to play it.

Learning is based on the 2013 curriculum with the target of students being able to: (1) explain and identify angles, types of angles (right, acute, and obtuse), and non-standard units of measurement, and (2) understand and practice moving in a balanced, flexible, agile, and resilient in the context of developing physical fitness through traditional games [22]. Learning begins with strengthening students' literacy through reading comprehension activities about *egrang* and the skills needed to play it, as shown in Fig. 11. Next, students are invited to practice playing *egrang*, as in Fig. 12.

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FIGURE 12. Learning activities by playing *Egrang*.

After the break, students are invited to learn the concept of angles and their types. Students are given a worksheet like in Fig. 13 to help strengthen the concept. The results of the worksheets showed that 2 students could not complete the given exercise because they were not yet fluent in reading so they did not understand the meaning of the sentence. While the other 17 students were able to complete the given exercise even though there were still 5 students who did not correctly distinguish acute and obtuse angles.

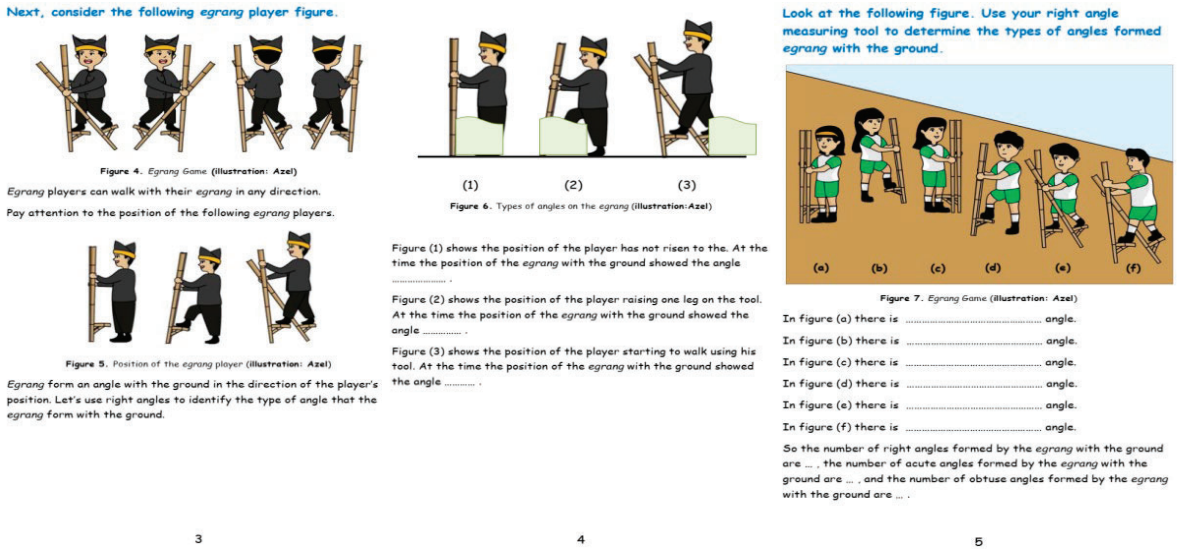

FIGURE 13. Angle concept worksheet.

The results of learning observations showed the average value of learning implementation was 4.37. Following Table 1, the implementation of learning includes high criteria. While the completion of the exercise in the worksheet shows an average value of 87. Following Table 2, the results of the completion of the exercise include high criteria.

The results of the learning implementation show that *egrang* can be used to understand the concept of angles and their types. This means that traditional games can be a medium for understanding mathematical concepts in elementary school. This is under the results of previous research which showed that traditional games can be used by children of various ages in learning such as mathematics and other subjects [14]. Traditional games can also be used as innovative learning media if applied and used appropriately, systematically, and practically [5]. In another study, it was stated that the application of educative-based traditional games in learning mathematics had an impact on increasing students' learning motivation which resulted in increased activity and learning outcomes [38].

In the context of thematic learning, the integration of *egrang* in sports can make students understand the concepts of moving balanced, flexible, agile, and resilient. This is supported by the results of previous studies which state that *egrang* has a significant effect on increasing endurance by 0.000, speed by 0.011, and balance by 0.000 [39]. In another study, it was stated that traditional games can increase the formation of a good balance in children [40]. These conditions are under the benefits of *egrang*, such as: developing and controlling children's motor skills; increasing the strength of the muscles of the legs, abdomen, arms, and hands; as well as training balance and body flexibility [8].

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CONCLUSION

Traditional games are part of a culture that contains a variety of knowledge. *Egrang* is played in almost all regions of Indonesia, including Surabaya and Banyuwangi. However, this game is rarely known by elementary and middle school students because of the influence of modern digital-based games. Among the knowledge contained in *egrang* are known as ethnomathematics and ethnosport. Ethnomathematics in *egrang* includes two-dimensional shapes, three-dimensional shapes, measurements, right triangles, angles, relationships between lines, counting, statistics, sets, relations, and probability. While the ethnosports contained in the *egrang* include locomotor motion, non-locomotor motion, manipulative motion, balance, flexibility, agility, and endurance. The ethnomathematics and ethnosports can be separated and then combined in the form of a thematic which is implemented in elementary school students. One thematic learning can be designed from learning mathematics on angle material and its types, with sports learning on the concepts of moving in a balanced, flexible, agile, and endurance. The results of this study can still be further developed in thematic learning with other materials, or identify other knowledge contained in *egrang* and conceptualized in thematic learning.

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Ethnomathematics and Ethnosport in Traditional Games for Thematic Learning

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Abstract. *Egrang* is one of the traditional games in Indonesia which is known in various regions with the same or different names. As part of a culture, traditional games contain a variety of knowledge that can be implemented in school learning. Generally, the implementation is done for one subject only. This study aims to explore *egrang*, identify ethnomathematics and ethnosports contained in it, and implement ethnomathematics and ethnosport in elementary school thematic learning. Research respondents are cultural figures in Banyuwangi and Surabaya, teachers, and third-grade students in an elementary school in Banyuwangi. The research uses ethnographic-based qualitative methods. Data were collected by observation, interviews, questionnaires, and tests. Data analysis was carried out qualitatively and quantitatively. The results showed that there were ethnomathematics and ethnosport in *egrang*. The sorting of ethnomathematics and ethnosports that is implemented in learning shows that learning in elementary school grade 3 with thematic concepts provides an average value learning implementation of 4.37 which includes high criteria, and the value of completion of exercise is 87 which includes high criteria. Research can be developed using other ethnomathematics and ethnosports in thematic learning in different classes or levels.

INTRODUCTION

Traditional games are one of the cultures that are still widely practiced in various countries, including Indonesia. Traditional games are fun activities that contain the main intrinsic motivational factors to attract students' attention and make them persistent and enthusiastic about the activity [1]. Traditional games are games that are historically based on local conditions and culture [2]. Traditional games are typical games with certain cultural backgrounds that have various forms and variationsand tend to use tools or objects in the surrounding environment without having to buy them so they require high imagination and creativity [3].

Games are one of entertainment for children and adults that can teach independence and contain meaningful learning [4]. By playing, the child can adapt to the world; acquire developments in language and concepts; can

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express themselves, adapt, and make contact with the environment [2], and noble values and moral messages such as the value of togetherness, honesty, skills, solidarity, courage, responsibility, encouragement to excel, and obedience to rules [3][5], taught to the next generation.

One of the traditional games that are well-known inIndonesia is *egrang*. *Egrang* is a traditional game that uses a pair of bamboo whose diameter is the same as an adult's arm, which is relatively straight and old, each bamboo is about 1,5 – 3 meters long, 20 – 30 cm from one of the bamboo bases is perforated to insert pieces of bamboo with a width of 20 cm as a footrest [6], as shown in Fig. 1.

FIGURE 1. *Egrang* Game (Documentation from KKD Surabaya).

Egrang can be done with the rules of a race or fast race, as well as knocking each other down [7]. *Egrang* provides benefits for developing and controlling children's motor skills; increasing the strength of the muscles of the legs, feet, abdomen, arms, and hands; training balance and flexibility [8]; training agility and accuracy; improving eye, hand, and foot coordination [9]. In this case, *egrang* can also be seen as a part of traditional sports. In addition, *egrang* also contain mathematical concepts such as counting, triangles, unit of length, Pythagoras, and linear inequalities of one variable [10]. From these opinions, it can be seen that *egrang* contains concepts of knowledge, including mathematics and sports. However, this requires further identification.

The concept of mathematics-related knowledge in culture is known as ethnomathematics. While the concept related to sports in culture is known as ethnosport. D'Ambrosio describes ethnomathematics as "the mathematics practiced by cultural groups, such as urban and rural communities, groups of workers, professional classes, children in a given age group, indigenous societies, and so many other groups that are identified by the objectives and traditions common to these groups" [11]. While ethnosport can be understood as various forms of physical activity found in traditional or national sports [12]. Thus, *egrang* can be used as a medium of learning, especially in mathematics and sports.

Traditional games can be used as innovative learning media if they are applied and used appropriately, systematically, and practically [5], and serve as learning tools in various subjects according to their characteristics to arouse students' motivation and interest in achieving learning objectives [13]. Traditional games can also be used to visualize abstract topics, increase student motivation in learning, generate critical thinking skills, increase information and collaborative activities, create an experiential learning environment and improve student achievement [14].

Introducing traditional games in learning is considered to increase motivation in all learning designs, such as attention and active participation of students in game-based learning activities; the relevance of game activities that are already known to students with learning objectives; provide a comfortable learning environment where students have control over the action required; as well as giving a sense of satisfaction because they can carry out activities that contain equality, unity, clarity, and justice that can be used effectively during learning [1]. This explanation makes it important to conduct research, including finding out learning concepts (especially mathematics and sports) in *egrang*, as well as knowing the implementation of *egrang* in elementary school thematic learning. This is related to the implementation of the "*merdeka*" curriculum in Indonesia which needs to be developed with the principle of diversification according to educational units, regional potential, and students [15]. In this case, *egrang* is part of the regional potential.

In addition, it is mentioned in the learning outcomes of the "*merdeka*" curriculum that one of the goals of learning mathematics is to equip students with the ability to relate between concepts in learning mathematics,

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between mathematical concepts across subjects, and between mathematical concepts and real-life [16]. For this reason, ethnomathematics and ethnosport of *egrang* are needed as a bridge to connect mathematical concepts with other subjects and real life.

Previous research has shown that the integration of traditional games in primary schools can improve learning outcomes, interest, involvement of children, and interactions with teachers and classmates [14]. Another study in an elementary school in Bali showed that the implementation of a scientific approach to learning to commun e based on traditional games had a positive effect on the achievement of grade 4 students [17]. Research on the use of traditional games in mathematics learning shows that the concept of numbers in traditional games is an interesting aspect that is useful for children to deal with various situations related to numbers [18].

Various studies have shown that ethnomathematics identification has been carried out in playing *egrang* [10] and the benefits of playing on *egrang* to strengthen the ability to move the human body [8][9]. Howeve o one has conducted studies on ethnomathematics and ethnosport together and applied m in learning. So that the results of this research are expected to become learning innovations, especially in the implementation of the *"merdeka"* curriculum, as well as being the basis for subsequent studies in implementing ethnomathematics and ethnosport into thematic learning. Based on the descriptions of various theories above, this research was conducted to identify ethnomathematics and ethnosport in *egrang* and then integrate them into traditional game-themed learning that combines mathematics and sports lessons.

METHOD

This research was conducted in two stages, including the ethnographic stage to identify ethnomathematics and ethnosport in *egrang*, as well as the experimental stage to determine the process and results of thematic learning that includes ethnomathematics and ethnosport in *egrang*. The ethnographic stage is carried out with 12 steps adopted by Spradley [19]. The results of the ethnographic stage are used as material for compiling learning tools for use in the learning experiment stage. The research flow is shown in Fig. 2.

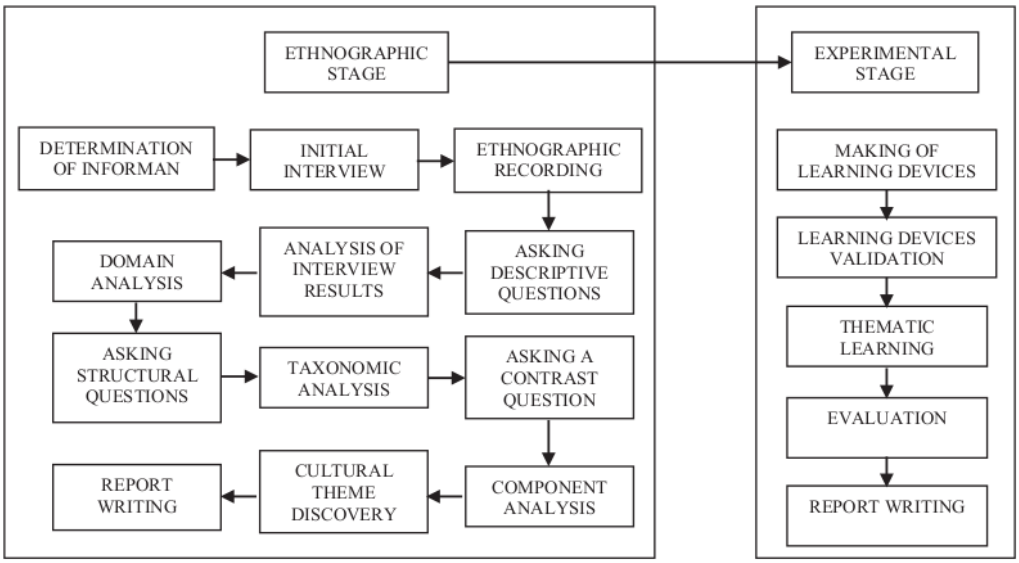

FIGURE 2. Research flow.

The research was conducted from November 2021 to July 2022. In ethnographic research, two informants are selected according to their background, and knowledge can explain and can practice *egrang*. The informants came from the traditional school community in Banyuwangi and the traditional game community in Surabaya. While the

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learning respondents are one elementary school teacher, one sports teacher, and 19 grade 3 students in an elementary school in Banyuwangi.

Data was collected through in-depth interviews, participatory observation, and cultural documentation during the ethnographic stage and was carried out with two selected informants. Meanwhile, in the experimental stage, data collection was carried out with learning observations and tests. In-depth interviews were conducted with 2 informants using interview guidelines. The participatory observation was carried out based on the observation sheet. While the cultural documentation was collected in the form of photos, videos, and interview transcripts. The data that has been collected is then analyzed together with the process of collecting data and writing research findings according to the steps in the ethnographic method [20][21]. Indicators for determining ethnomathematics and ethnosport are based on basic and secondary education competencies [22].

The data at the ethnographic stage becomes the material for making *egrang*-based thematic learning designs by combining ethnomathematics and ethnosport. The learning design is realized in the form of lesson plans and student worksheets containing tests. During the learning process, the implementation of the learning design was observed. And at the end of the lesson, students are asked to complete a test on a worksheet. The data obtained at the experimental stage were analyzed quantitatively. Thematic learning based on *egrang* by combining ethnomathematics and ethnosport is effective if the results of observations show a minimum average of high criteria (according to Table 1) and the results of student test completion show a minimum average of high criteria (according to Table 2) [23].

TABLE 1. Criteria for observation of learning implementation results.

Interval	Learning Implementation Criteria
$1 \leq \overline{X} < 2$	Very low
$2 \leq \overline{X} < 3$	Low
$3 \leq \overline{X} < 4$	Currently
$4 \leq \overline{X} < 5$	High
$\overline{X} = 5$	Very high

Adapted from[23].

TABLE 2. Criteria for student test completion results.

Interval	Test Completion Results Criteria
$0 \leq \overline{X} < 40$	Very low
$40 \leq \overline{X} < 60$	Low
$60 \leq \overline{X} < 75$	Currently
$75 \leq \overline{X} < 90$	High
$90 \leq \overline{X} \leq 100$	Very high

Adapted from[23].

RESULTS AND DISCUSSION

Egrang Exploration

The ethnographic stage in this study was carried out at the Sekolah Adat Kampoeng Batara (SAKB) Banyuwangi and Komunitas Kampung Dolanan (KKD) Surabaya. SAKB is one of the traditional schools in Banyuwangi which was established to teach culture to the next generation. While KKD is a cultural conservation community in Surabaya that actively teaches traditional games. The first informant is the founder and teacher at SAKB Banyuwangi. The second informant is the founder and executor of the KKD Surabaya. The results of the *egrang* exploration show that the main material for the *egrang* is bamboo, *apus*or*watu*, or other types that are easy to find.

Generally, a pair of *egrang* requires about 4 meters of bamboo or as long as needed. Each stem consists of six to seven bamboo segments, each of which is about 25 to 35 cm long. The length of the handle of the *egrang* is adjusted to the player's height but must be longer. The footrest part of the whole bamboo requires 25 to 30 cm long bamboo with a diameter more than the diameter of the *egrang* handle bamboo. The side of the bamboo is perforated as large

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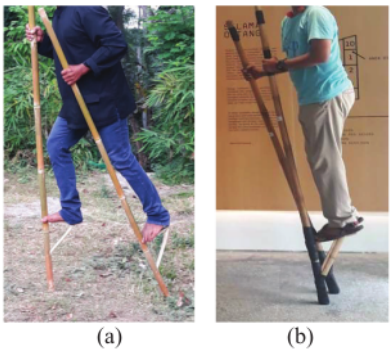
as the diameter of the bamboo handle, then the bamboo part of the handle is inserted into another bamboo which is used as a foothold.

If you want to use a piece of bamboo as a footrest, then the bamboo part of the handle must first be perforated the size of the width of the footrest. After that, the bamboo split is inserted into the hole and then nailed. In addition, a supporting part using bamboo with a length as needed is added, as shown in Fig. 3(a) on the right. Supports function as holding bamboo steps and bamboo handles. All sizes are adapted to existing materials and players' needs.



(a) (b)

FIGURE 3. *Egrang* (documentation from (a) SAKB Banyuwangi and (b) KKD Surabaya).

In Banyuwangi, *egrang* can be played with various game modifications, such as fast or slow races, *egrang pecut*, and *egrang* soccer. Whereas in Surabaya, generally *egrang* is only used for agility games or *egrang* fighting. Fast or slow fighting games are carried out to get a winner among several players, as shown in Fig. 4(a). The player is declared the winner in the fast race if he reaches the deadline first. Meanwhile, the player is declared the winner in the slow fight if he reaches the end of the predetermined limit.

(a) (b)

FIGURE 4. (a) *Egrang* Fight (Documentation KKD Surabaya) and (b) *Egrang Pecut* (Documentation SAKB Banyuwangi).

Egrang pecut is carried out between two groups of players, as shown in Fig. 4(b). The number of members of each group is adjusted to the number of players available and the availability of game tools. A first group is a group of *egrang* players. While the second group is the holder of the *pecut* (whip) or vice versa. The group of *egrang* players must be able to maintain their position on the *egrang* while continuing to walk or dance. The group of *pecut* holders must try to bring down the *egrang* players by whipping the bottom of the *egrang*. *Pecut* is usually made from interwoven banana leaf stems that have dried. *Pecut* should not hit the player's bodybut on the *egrang* tool. If all *egrang* players can be dropped from their tools, then the group is declared defeated. Then the two groups swap roles.

Egrang soccer is a game that is modified from the usual football game, but players do it on the *egrang*. This game can be played individually one on one (as in Fig. 5) or in groups. The game begins by making the boundaries of the playing area and marking the goal of each player/group. The size of the boundaries of the playing area and the

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goal is made by agreement. Next, the two players/groups make a *suit* to determine the player who kicks the ball first. The ball is made of a medium-sized bamboo basket with a side length of approximately 20 cm.

FIGURE 5. *Egrang* soccer.

The suit is a one-on-one player draw using the three-finger rule, namely the thumb, index finger, and little finger. The rules of the draw are that the thumb wins against the index finger, the index finger wins against the little finger, and the little finger wins against the thumb. The player/group of players must try to get the ball into the opponent's goal as much as possible in the allotted time. Players/groups of players are declared to win if they get the most points (goals) until the time limit has been determined.

Ethnomathematics and Ethnosport in *Egrang*

Based on the exploration results, it can be determined that the domains in the *egrang* game processes and game tools. Furthermore, the domain becomes the basis for taxonomic analysis to find cultural themes in the context of ethnomathematics and ethnosports. The taxonomic analysis is based on the basic competencies of mathematics and sports subjects for primary and secondary education [22].

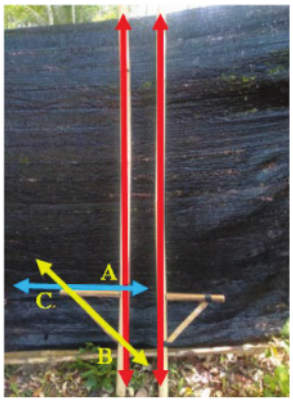

FIGURE 6. A Pair of *Egrang* tools.

The *egrang* uses a tool made of tubular bamboo that contains six to seven bamboo segments. Bamboo contains the concept of a tube because it is a shape that has a congruent base and is covered in the form of a circle [24]. If each bamboo-segment is about 35 cm long, then the *egrang* is about 2 to 2.5 meters long (as shown by the red line in Fig. 6). While the cross-section of bamboo is circular with a diameter of 5 to 7 cm. A circle is a collection of points that are equidistant from a given point [25]. This condition shows the concept of measurement with non-standard units and circles. Measuring is an activity to compare the measured quantity with similar quantities used as units [26]. It is further explained that non-standard units are units that are not designated as scientific units of measurement.

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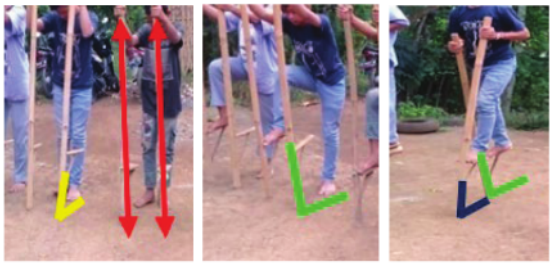
The length of the bamboo used to make the *egrang* is adjusted to the player's height and generally must be longer than the player's height. This condition shows the concept of measurement.The installation of the footing causes the *egrang* handles, footings and supports to form a right triangle (as shown by the red, blue, and yellow lines in Fig. 6).This shape is called a right triangle because one of the angles is equal to 90 [27], which is between the *egrang* handle and the footing.

Figure 6 shows the two *egrang* handles (red lines) showing the relationship of two parallel lines because if they are positioned in a plot the two lines do not intersect [28]. Each *egrang* handle is connected with a footing and support. The *egrang* handle (depicted as a red line) and the footing (depicted as a blue line) intersect at point A. The handle and support (depicted as a yellow line) intersect at point B. While the footing and support intersect at point C. The concept of the intersecting line occurs because the two lines have exactly one common point [28].

The *egrang* handles, steps, and supports form triangle ABC which contains right angles at vertices A and acute angles at vertices B and C. The concept of an acute angle is known because the measure of the angle is less than 90 [28]. As a result, on the *egrang*, it is also known that there is a Pythagorean concept, which is in a triangle if the square of one side length is equal to the sum of the squares of the lengths of the other sides, then the triangle is a right triangle [29].

The game of fast fighting or slow *egrang* competition can be done by two or more players. All players standing in the starting position form a line in their order. In this position, the process of counting the *egrang* players can be carried out. Numbering is the activity of determining the number of objects or activities that are carried out by mentioning a series of number names starting from one, and pointing to a different object or activity when the name of each number is mentioned [30].

Players stand in a line (form a straight line). While the *egrang* are positioned parallel to each other and perpendicular to the ground. The red line in Fig. 7(a) indicates the parallel position of the *egrang*, while the yellow markings indicate the perpendicular position or at right angles to the ground.



(a) (b) (c)

FIGURE 7. (a) Starting position, (b) prep position and (c) walking position.

The player follows the initial signal for preparation by raising one foot to the *egrang*. In this position, the *egrang* and the ground form an obtuse angle, as shown in the green markings in Fig. 7(b). An obtuse angle is an angle whose measure is between 90 and 180 [28]. The player starts walking on cue. To maintain balance during walking, players position one *egrang* at an acute angle (blue mark) with the ground and the other *egrang* at an obtuse angle (green marked) with the ground, as in Fig. 7(c).

The process of recording the time it takes players to enter the game's end limit includes the concept of measurement. Data on the sequence of players entering the deadline and the time taken from the initial limit to the final limit can be used as a data collection process in statistical concepts. Data is several pieces of information that can provide an overview of a situation or problem [31]. Determining the order of the players is done with the concept of comparing the time taken between players.

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FIGURE 8. Whip group attempts to bring down *Egrang* player.

In *egrang pecut* grouping is carried out between *egrang* players and whippers.The grouping shows the concept of a set, which is a collection of objects that can be clearly defined [25]. Each member of the whipping group must try to knock down a nearby *egrang* player by whipping the bottom of the *egrang*. The opportunity for each member of the whipped group to knock down every member of the *egrang* player shows the concept of relationship, as shown by the red and yellow arrows in Fig. 8 above. A relation occurs if there are members of the first set that are paired with members of the second set [25]. If all *egrang* players can be dropped until they are unable to climb back up to the *egrang* again, then the group of *egrang* players is declared defeated. The frequency with which players fall off their *egrang* can become data collected in statistical concepts.

Egrang football which is done in groups contains the concept of a set in the process of group formation. The boundaries of the game area are generally made by agreement in the form of a rectangle with the size according to the conditions of the game area. The game area is rectangular because it is a flat shape that has two pairs of opposite sides of equal length and four right angles [27]. On opposite sides of the playing area, a goal boundary is made for each player/group, as shown in Fig.9.

FIGURE 9. *Egrang*soccer game area.

Both players/groups start the game with a *suit* to determine the player who kicks the ball first. The *suit* rule contains the concept of probability, which is a measure of the certainty of the occurrence of an event [24]. Many goals scored by players can be recorded as data that is part of the statistical concept. The game is played at the agreed time. So there is a concept of measuring time in *egrang* football. While the bamboo basket, as shown in Fig. 10, used as a ball contains the concept of a rectangular prism, which is a polyhedron that has two pairs of parallel sides and all other sides are parallel to a line that cuts the loaders of the two parallel sides[28].

FIGURE 10. Basket used as ball.

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Egrang players move on *egrang* to walk in all directions or move in one particular place. This shows the concept of locomotor motion and non-locomotor motion. Locomotor is the movement of the body from one place to another, such as: walking, running, tiptoeing, jumping, rolling, galloping, crawling, and climbing [32][33]. On the other hand, movements that do not indicate displacement are known as non-locomotor.

In certain games such as *egrang* football, players also need to develop their movements when facing the ball. The development of this movement involves the activity of the feet and hands that move the *egrang*. This shows the existence of manipulative motion. Manipulative is a movement that is developed when dealing with various objects, involving body parts such as hands, feet, and head [32][34].

In locomotor, non-locomotor, and manipulative movements performed, players must also be able to maintain balance, flexibility, agility, and endurance to maintain their position on the *egrang*. Balance is the ability to maintain body balance in various positions, while flexibility is the ability to perform exercises with a large or wide amplitude of movement [35]. Agility is the ability to change direction quickly by maintaining balance while moving [36]. Endurance is the time that shows the length of time a person can perform an activity that is far from fatigue [37].

Combining Ethnomathematics and Ethnosport in *Egrang*-Based Thematic Learning

Egrang-based thematic learning is implemented for 3rd graders in an elementary school in Banyuwangi. Respondents were one elementary school teacher, one sports teacher, and 19 grade 3 students. Learning was carried out in one meeting. The subjects chosen to be integrated into the thematic concepts are mathematics and sports.

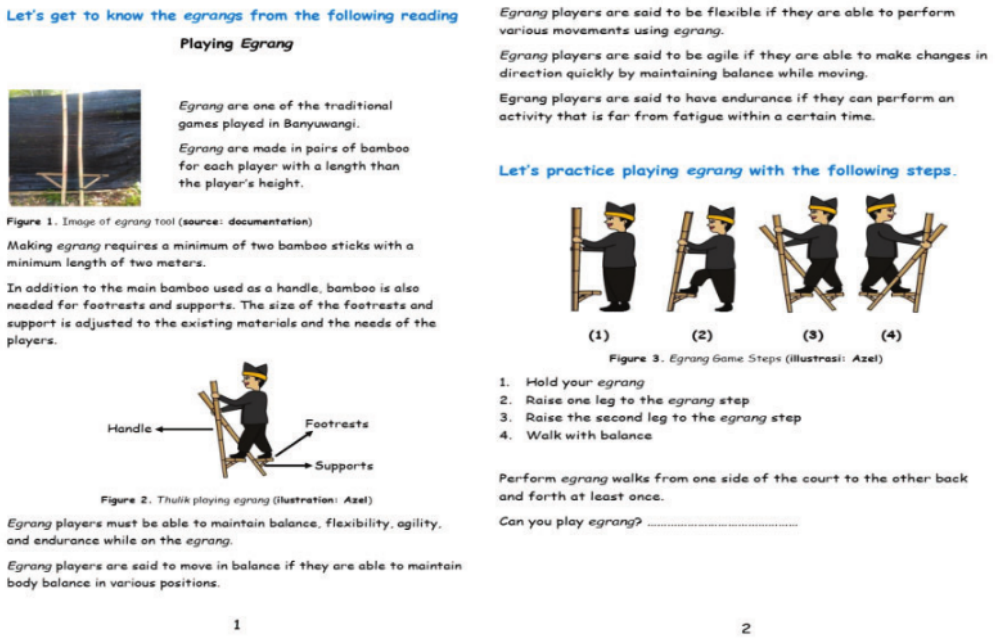

FIGURE 11. Readings about *Egrang*and how to play it.

Learning is based on the 2013 curriculum with the target of students being able to: (1) explain and identify angles, types of angles (right, acute, and obtuse), and non-standard units of measurement, and (2) understand and practice moving in a balanced, flexible, agile, and resilient in the context of developing physical fitness through traditional games [22]. Learning begins with strengthening students' literacy through reading comprehension activities about *egrang* and the skills needed to play it, as shown in Fig. 11. Next, students are invited to practice playing *egrang*, as in Fig. 12.

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FIGURE 12. Learning activities by playing *Egrang*.

After the break, students are invited to learn the concept of angles and their types. Students are given a worksheet like in Fig. 13 to help strengthen the concept. The results of the worksheets showed that 2 students could not complete the given exercise because they were not yet fluent in reading so they did not understand the meaning of the sentence. While the other 17 students were able to complete the given exercise even though there were still 5 students who did not correctly distinguish acute and obtuse angles.

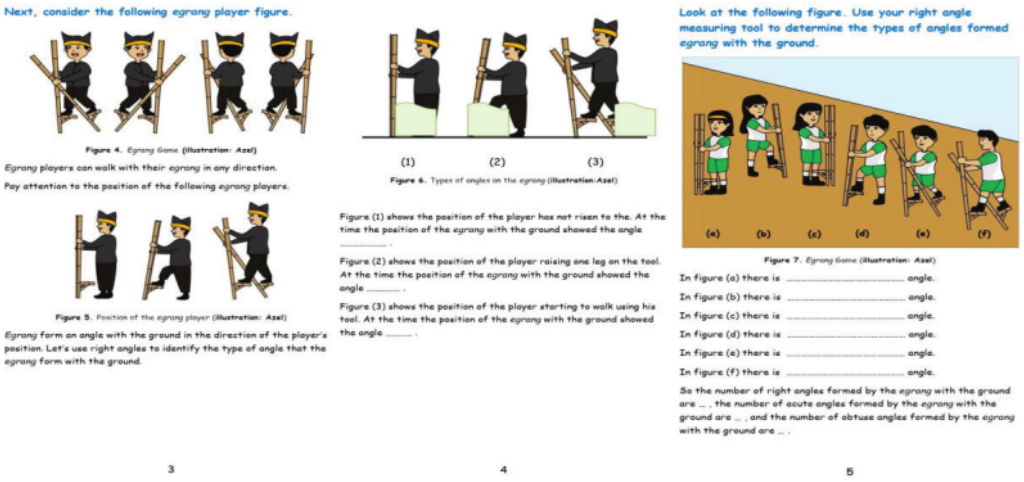

FIGURE 13. Angle concept worksheet.

The results of learning observations showed the average value of learning implementation was 4.37. Following Table 1, the implementation of learning includes high criteria. While the completion of the exercise in the worksheet shows an average value of 87. Following Table 2, the results of the completion of the exercise include high criteria.

The results of the learning implementation show that *egrang* can be used to understand the concept of angles and their types. This means that traditional games can be a medium for understanding mathematical concepts in elementary school. This is under the results of previous research which showed that traditional games can be used by children of various ages in learning such as mathematics and other subjects [14]. Traditional games can also be used as innovative learning media if applied and used appropriately, systematically, and practically [5]. In another study, it was stated that the application of educative-based traditional games in learning mathematics had an impact on increasing students' learning motivation which resulted in increased activity and learning outcomes [38].

In the context of thematic learning, the integration of *egrang* in sports can make students understand the concepts of moving balanced, flexible, agile, and resilient. This is supported by the results of previous studies which state that *egrang* has a significant effect on increasing endurance by 0.000, speed by 0.011, and balance by 0.000 [39]. In another study, it was stated that traditional games can increase the formation of a good balance in children [40]. These conditions are under the benefits of *egrang*, such as: developing and controlling children's motor skills; increasing the strength of the muscles of the legs, abdomen, arms, and hands; as well as training balance and body flexibility [8].

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CONCLUSION

Traditional games are part of a culture that contains a variety of knowledge. *Egrang* is played in almost all regions of Indonesia, including Surabaya and Banyuwangi. However, the game is rarely known by elementary and middle school students because of the influence of modern digital-based games. Among the knowledge contained in *egrang* are known as ethnomathematics and ethnosport. Ethnomathematics in *egrang* includes two-dimensional shapes, three-dimensional shapes, measurements, right triangles, angles, relationships between lines, counting, statistics, sets, relations, and probability. While the ethnosports contained in the *egrang* include locomotor motion, non-locomotor motion, manipulative motion, balance, flexibility, agility, and endurance. The ethnomathematics and ethnosports can be separated and then combined in the form of a thematic which is implemented in elementary school students. One thematic learning can be designed from learning mathematics on angle material and its types, with sports learning on the concepts of moving in a balanced, flexible, agile, and endurance. The results of this study can still be further developed in thematic learning with other materials, or identify other knowledge contained in *egrang* and conceptualized in thematic learning.

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