# The use of mathematical games in the early childhood settings in Palestine

**Article** *in* Education 3-13 · November 2024

DOI: 10.1080/03004279.2022.2149277



**4 authors**, including:

Buad Mohamed Khales
Al-Quds University
**20** PUBLICATIONS **43** CITATIONS

SEE PROFILE

Fathi Mahmoud Ihmeideh
Hashemite University
**62** PUBLICATIONS **1,091** CITATIONS

SEE PROFILE

Routledge
Taylor & Francis Group

Education 3-13

International Journal of Primary, Elementary and Early Years Education

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rett20

# The use of mathematical games in the early childhood settings in Palestine

Buad Al Khales, Intisar Natsheh, Fathi Ihmeideh & Mina Kim

**To cite this article:** Buad Al Khales, Intisar Natsheh, Fathi Ihmeideh & Mina Kim (2024) The use of mathematical games in the early childhood settings in Palestine, Education 3-13, 52:8, 1372-1386, DOI: 10.1080/03004279.2022.2149277

**To link to this article:** https://doi.org/10.1080/03004279.2022.2149277

EDUCATION 3-13
2024, VOL. 52, NO. 8, 1372–1386
https://doi.org/10.1080/03004279.2022.2149277



# The use of mathematical games in the early childhood settings in Palestine

Buad Al Khales [a], Intisar Natsheh[b], Fathi Ihmeideh [c] and Mina Kim[d]

[a]Elementary Education and Kindergarten Department, Al-Quds University, Jerusalem, Palestine; [b]Al-Quds Bard College for Art and Sciences, Al-Quds University, Jerusalem, Palestine; [c]Child Education Department, Queen Rania Faculty for Childhood, The Hashemite University, Zarqa, Jordan; [d]Elementary Education Department, San Francisco State University, San Francisco, CA, USA

**ABSTRACT**

This study aims to examine how five-year-old children demonstrate their learning through mathematical games in preschool settings in Palestine. It also explored the perspectives of children and teachers of different stages of play. The sample consisted of 90 children and 6 teachers. Children were guided to a wide range of mathematical games. Children roamed freely and explored by themselves at first, and then teachers provided suitable environments and instructions to facilitate children's experiences and learning afterward. Qualitative research methods were utilised using different research instruments, including observational notes, teacher interviews, children interviews, and reflective journals. The results show that mathematical games opened new horizons for children to investigate, discover and create mathematical concepts. It allowed children to use their creativity and develop their imagination, skilfulness, and other strengths. The children learned scientific concepts, and their problem-solving ability was enhanced and expanded. The results also indicate that teachers were able to broaden their perspectives regarding students' learning abilities as they observed children invent their games and express their interests with limited support from their teachers. In light of these results, it is recommended that children's learning through play should be promoted in Palestinian preschool settings.

**ARTICLE HISTORY**
Received 7 April 2022
Accepted 3 October 2022

**KEYWORDS**
Preschool; mathematical games; mathematical concepts; free play; guided play

## Introduction

Children's educational and sociocultural experiences in their preschool years substantially impact their readiness for school, especially in their achievements in mathematics (Reynolds Ou and Topitzes 2004; Weisberg, Hirsh-Pasek and Golinkoff 2013). As a valuable tool to develop thinking abilities, problem-solving skills, and a primary source in enriching the educational process, educational games are considered an essential pedagogical and psychological tool for young children's development and learning (Costello 2013; Rabiner, Godwin, and Dodge 2016). Researchers pointed out that mathematical games are useful teaching tools that help children build their mathematical understanding (Bragg 2006; Gough 1999), provide opportunities for social interaction (Monroe and Nelson 2003), and increase children's engagement and enjoyment with mathematics (Bragg 2006).

The education system in the Palestinian Authority is divided into two stages. Stage one, the basic education covering grades from one to ten, consists of two phases: (1) preparation phase from first

**CONTACT** Fathi Ihmeideh fathiihmeideh@hotmail.com; fathi@hu.edu.jo Child Education Department –Queen Rania Faculty for Childhood, The Hashemite University, P.O. box 330127, Zarqa 13133, Jordan

to fourth grades, and empowerment phase from fifth to tenth grades. The second stage is secondary education, which covers eleventh-twelfth grades. The Ministry of Education and Higher Education (MOEHE) in the Palestinian Authority is in charge of the kindergartens and schools on the West bank in Gaza. The preschool education phase provides educational and learning services for children aged 4–5. Unlike the other two educational stages, which are mandatory, preschool education phase is still non-compulsory in the Palestinian educational system.

In the Palestinian pre-school education context, teachers emphasise the role in a play for children's educational and personal growth. Within the great effort of prioritising nurturing early care in Palestine, Early Childhood Development (ECD) has been putting pressure to ensure young children could learn to their full potential. However, before this study, teachers were more used to traditional approaches to teaching, such as giving particular instructions and directions to the children and demonstrating to follow. Within the traditional way of teaching, children could not have enough opportunities to experiment, investigate and discover cognitive concepts independently. Accordingly, some limitations may impede children's development of conceptual understanding and their abilities to ask questions and challenge themselves. Through this study, the idea of free play was imposed in the Palestinian early childhood education context to give children chances to engage in learning using their utmost creativity and imagination. In this study, we adopted the definition of free play from the Play and Playground Encyclopedia: it is

> an unstructured, voluntary, child-initiated activity that allows children to develop their imaginations while exploring and experiencing the world around them. The spontaneous play comes naturally from children's natural curiosity, love of discovery, and enthusiasm. (Play and Playground Encyclopedia 2010, 213)

By observing open-ended spaces, children could take part in free play as a part of the daily routine to work both on fine and gross motor skills using different parts of their bodies and develop their thinking skills making trial and error.

The purpose of this study was to investigate how five years old children approached the mathematical games differently in three phases (1) free play, (2) guided play, and (3) the combination of free play and guided play. Additionally, we addressed teachers' perspectives on introducing self-directed mathematical games in their classrooms. Specifically, the study addresses the following research questions:

- How do children respond to new and unfamiliar mathematical games within two open-ended free-play environments?
- What are children's attitudes when approaching educational games?
- What are teachers' perspectives toward self-directed mathematical games in their classroom?

## Theoretical underpinning

Piaget (1963) viewed play as an activity that enhances the ability to use symbols and symbolic representation. He believed that young children's symbolic play indicates their cognitive and social development (Piaget, 1963). Piaget also perceived play as the 'language of childhood', which facilitates and transforms a young child's cognitive processes. Similarly, Vygotsky ([1933] 1978) sees play as having an effective role in the development of young children and notes that while playing, a child always behaves '*above* his average age, *above* his daily behaviour; in play it is as though he were a *head* taller than *himself*' (Vygotsky 1978, 74). This leads to the conclusion that play provides the best context for growing and maturing young children's cognitive and social processes, or what Elkonin terms their 'developmental accomplishments' (Vygotsky 1977). Play is a means of learning that 'contains all developmental tendencies in a condensed form and is itself a major source of development' (Vygotsky 1978, 102). Through play, children learn to: elucidate what they see, infer relationships, exercise different roles, and experience their growing capabilities (Vygotsky 1999). According

to Vygotsky, 'play is the best tool for preparation for future life … play is self-education' (Vygotsky 1998, 26).

Erikson ([1950] 1963) believes that in the Autonomy vs. Shame-and-Doubt stage, the child starts to discover many skills and abilities, such as putting clothes or shoes on and playing with toys. Such skills can represent the development of independence and autonomy. It is, therefore, important for parents to provide their children with opportunities to explore their abilities. The initiative-and-guilt stage that Erikson subsequently considers is the play age at which a child interacts with other children at school to explore his interpersonal skills through activities planning and cooperation with others. Thus, play allows children to develop a sense of well-being and emotional responses and improve their interpersonal skills. Going along with that, there is a strong tendency today among experts to agree that play facilitates the development of a variety of children's social, cognitive, motor, and linguistic skills (Bjorklund & Gardiner 2011; Bordova, Germeroth & Leong 2013; Fisher et al. 2011; Lynch 2015). These can be included: thinking and problem-solving, language acquisition, a deeper understanding of numeracy concepts, social and emotional self-regulation, exploring one's environment, experimenting with materials and ideas as they develop theories around the world, and helping young children to start thinking before acting as opposed to acting in response to stimuli, understanding the physical and social worlds, expression and management of feelings, creativity development, divergent thinking skills and emotional associations, ability to deal with symbolic systems, experimenting with new activities, and enhance conceptual understanding.

Research studies have indicated that when children are allowed to engage in play experiences, they gain independence by allowing them to explore and test new abilities, and over time gives them a greater understanding of self through controlling their body and the environment around them, leading ultimately to the ability to make rational and prudent decisions (Hindawi 2003). Moreover, play helps children integrate different aspects of their development – physically, emotionally, educationally, and socially – and aids their understanding of themselves and their environment and how to function within it (Fountaine, Liguori, Mozumdar, and Schuna 2011). Furthermore, play allows to develop their creativity since it requires them to imagine and anticipate the results of their play. Interactive play with other children teaches cooperation, negotiation, and problem-solving skills, and developing a sharing ethos and the ability to work within groups (Anderson-McNamee and Bailey 2010). Thus, play assists in identifying interests and in developing the ability to recover quickly from setbacks (Anderson-McNamee and Bailey 2010).

It is also claimed that interactive games can spark children's interest in all learning experiences, especially mathematics. As most mathematical experiences focus on two areas in accordance with common core requirements on representation, whole numbers relationships, or spatial description (Kamii, Miyakawa, and Kato 2004), mathematical games are used extensively to develop mathematical concepts and as practical tools for enhancing children's mathematical understanding. They simultaneously make teaching and learning activities more enjoyable but challenging, especially when combined with logical reasoning.

## The role of free play and guided play

Direct instruction and free play are the two main pedagogical methods widely used in Palestinian preschool education. Within the concept of direct instruction, children are considered passive recipients of their teacher's instructions. On the other hand, within the concept of free play, children can choose their games and methods of play without any teacher's intervention. Both pedagogical approaches support learning in different ways: free play enhances children's socio-emotional development (Pagani, Fitzpatrick, Archambault & Janosz 2010; Romano, Babchishin, Pagani & Kohen 2010; Singer & Singer 1990), and their language and literacy learning (e.g. Lillard et al. 2013; Neuman & Roskos 1992; Weisberg, Hirsh-Pasek & Golinkoff 2013). On the other hand, in guided play, adults provide objects games with rules, or experiences that support educational goals. They can

scaffold children's play by joining them as co-players, posing higher-order questions, reflecting on the children's discoveries, or fostering further exploration or new aspects of their activities (Fisher et al. 2011; Hirsch-Pasek, Golinkoff, Berk & Singer 2009; White 2012). Even though teachers become children's guidance in guided play, it is still based on children's interests, preferences, and willingness to participate.

## Educational and instructional games

An educational game can be described as a tool for promoting conceptual understanding and training children in various learning skills. It is also a tool that helps teachers to reach their educational goals (Prensky 2001). Educators acknowledge the psychological benefits of educational games in learning, peer interaction, problem-solving skills, commitment and adherence to rules, personal enjoyment, and creativity (Abu Raya 2001). They foster and reinforce children's attention to learning (Akinsola 2007), help them take maximal advantage of learning, develop positive attitudes, and improve their mental capacity (Najdi and El Sheikh 2012).

Effective teaching and learning, ideally in tandem with a changeable and renewable education system, must utilise the proper educational methodologies and pedagogies (Mahmoud, Al-Tunh 2014). In like manner, teachers bring instructional materials into their classrooms to raise children's engagement and motivation. Liu and Chu (2010) stress that instructional games such as card games, board games, locally constructed or commercial games, physical games, puzzles, computer games, and online games (Udosen and Ekpo 2016) can offer tremendous advantages, including the potential to stimulate children's active involvement in the learning process more than other instructional materials. Instructional games expose children to various forms of fun and entertaining way of learning and are, therefore, perceived as a practical tool to foster their understanding (Prensky 2003).

In addition, Byrne (1995) described instructional games as a kind of play governed by rules. Instructional games to minimise the rigidity and formality of the teaching and learning process and supplement different pedagogical methods. Learners are more involved when their learning experiences are active and exploratory. Therefore, once it is designed appropriately to achieve students' learning objectives, instructional games positively impact children's experiences and achievements (Prensky 2001).

## Methods

### *Participants*

The participants of the study were 90 children and 6 teachers. They were selected from two preschool settings in East Jerusalem using a stratified random sample method. These two preschool settings contained six kindergarten classes with 30 children in each class. Each child was given a number from 1-30, and 15 children were randomly chosen from each class. The children's ages ranged from five to five and a half years old.

For six participating teachers in this study, each of them was given a letter code: A, B, C, D, E, and F. All of them hold a Bachelor's degree in Early Childhood Education, and their experience varied between eight and fifteen years, with an average of 11 years in the field. They were all females, as all staff working in the preschool settings in Palestine are females.

### *Methodological approach*

The qualitative approach is utilised in this study. This approach aims to throw as much light as possible on how participants believe, think, behave and feel. It seeks to gain access to their images, values, attitudes, and motivations behind their behaviour. It also aims to understand the meaning behind the participants' responses (Seale,Gobo, Gurbrium and Silverman 2006). In this approach,

the researchers explore the mathematical games in preschool settings in-depth, and the flexibility of this approach helps the researchers provide rich information.

In this approach, researchers tend to deal with the question of why things are. The researchers using the qualitative approach are also interested in how different people make sense of their lives (Denzin and Lincoln 2000).

### *Research instrument*

The data was collected from different research instruments, including: (a) observational notes, (b) teacher interviews, (c) focus children interviews, and (d) reflective journals. The researchers observed each class six times to see (1) how children interact with games within the two stages of free play and guided play, (2) what kinds of questions children ask while playing the games, and (3) how children interact with others in the group setting. To ensure the validity of this observation and interview analysis, each researcher individually analyzed four class activities videotaped. Then the results were compared. The coefficients of agreement and difference were estimated between the two results, which were 83.7 for observations and 82 for interviews using Cooper's Equation; these results indicate that the observation and the interview's analysis have good degrees of validity.

The interview was used for multi-fold purpose: (1) exploring the methods used by teachers in exposing children to educational games; (2) examining teachers' approaches to the two stages of free play; (3) considering teachers' ideas about children's self-directed games; and (4) discovering what each teacher learned from that experience. Teacher interviews were conducted before, during, and after the mathematical games using the following open-ended questions:

- How and why do you introduce games to the children in your class? [before the games]
- What are your opinions about the two stages of introducing self-directed games the researchers used? [during the games], and
- What have you noticed about your students? [after the games]

The focus children's interviews were used to identify children's perspectives about their play and what they had learned from it. The researchers chose three random children from each group, so six children from each classroom. This focus children's interviews were held after implementing the two stages of play.

Teachers' reflective journals were utilised to explore teachers' and children's perspectives about their experience in using educational games as suggested by researchers and the effectiveness of using the mathematical games. All teachers who participated in the study were asked to write their reflections on their whole experiences to reflect their ideas about how they perceived the use of educational games, how they and their children's roles were represented while playing, and what they have learned from implementing educational games in their classrooms. To ensure the validity and reliability of teachers' reflective journals analysis, the researchers estimated the validity by analyzing a random sample of 20 of the reflective journals after agreeing on the precise meaning of the words and expressions, and the percentage agreement index was calculated using Holsti's (1969) formula:

$$PA_0 = 2A\backslash(N_1 + N_2)$$

$N_1$: The number of categories analyzed the first time; $N_2$: The number of categories analyzed the second time; 2A: Number of categories agreed upon in the first and second time

The validity among participants was a coefficient of 84%, and within, it was 83%.

The reflective teaching journals were also used to search out possible meanings of our data regarding what they meant for teaching philosophy and professional teaching practices in Palestine. While looking back over those data, the researchers tried to see how it all influenced teachers' understanding and their philosophy of early childhood education toward self-directed math games.

### Data collection

This study was conducted in the classroom of each preschool. The children were divided into two groups, and each researcher worked with one of the groups using a different game each time. The researchers met with each group of children ($n = 15$) (i.e. the participants from each class) to examine their expectations from the experiment. They introduced the experiment to the children in the following manner:

> You will play different games, and we will meet you several times to listen to your thoughts and feelings.

Permission from the class teachers and the principal was secured for the researchers to work with the children outside the classes. Research ethics have required that participants, whether children or teachers, remain unnamed and referred to by a given code. Children were asked whether they wanted to participate or not. Before conducting the study, the researchers explained the purpose of the study to the teachers and assured them about confidentiality and anonymity. The researchers conducted six observations for each session, which took an hour. Next, eight focus children were interviewed at the end of each session after implementing the two stages of play with six children from each preschool. On-site inquiry and collaboration among teachers helped this study frame how children learn and develop their skills through educational games.

### Ethical consideration

Consent was sought from the MOEHE to carry out this research. The principals of the schools, teachers, and the parents of the children were met and informed of the study's aims. In addition, verbal consent was sought from children before the focus interview. Throughout the study, children were also given the right to withdraw at any time and will be free to decline to answer a particular interview question. Teachers were also given a choice for their interviews and class observation to be recorded or not. The anonymity of the teachers and parents of children was also taken into account: no information identifying the respondents was disclosed.

### Data analysis

This qualitative study emphasised the importance of interaction and environment of implementing self-directed math games in a conventional classroom in Palestine. On-going close observations in each classroom helped this study frame how children learn and develop their skills in multiple sections. Accordingly, the data were subjected to thematic and narrative analysis to answer the research questions. All interviews were videotaped and transcribed. Each researcher independently observed half of the participants. After the observation, two researchers discussed and compared their findings. Then, the results from interviews, observations, and reflective journals were categorised into two themes: teacher beliefs and practices. As we observed teacher–child and child–child interactions and made adjustments for better stimulation through self-directed math games, we were able to collect data and evidence to support our claim that early educators must tap into children's natural love of learning and improve their teaching strategies to encourage young children's learning and development.

## Findings

The results indicated that children stepped into new horizons for investigating, discovering, and creating new knowledge after being exposed to three different stages of mathematical games. Through playing, children learned mathematical concepts, such as numbers, more and less, shapes, and scientific concepts, such as animals (primary colours, and secondary colours), and their ability to solve problems was enhanced and expanded. In addition, play allowed children to use their creativity and develop their imagination, skilfulness, and other strengths. The results indicated that teachers observed children

invent their games and express their interests with limited amounts of support from their teachers. Furthermore, teachers have new roles in facilitating and supporting self-directed mathematical games for young children to discover categorise and make sense of the world around them.

The results of the study are addressed by each research question as follows.

To get to the first research question, 'How do children respond to new and unfamiliar educational games?' we first observed how young children manipulated games independently and then interviewed focus children at the end of each session. As we continued to collect and analyse data from close observations and documentation of their responses, three main stages emerged: free play, guided play, and the combination of free play and guided play.

### *Stage one: free play*

First of all, children were given each game in a day, and they were encouraged to play on their own. To investigate how they tackled new games, we started with the following questions: 'How did the children design their instructions?' and 'Could they see alternative ways of playing?' Children's responses varied at this stage. Initially, they examined the games to discover how they could play with them. Some of the children asked for game instructions, but the researchers urged them to think independently and try to cooperate with their peers in their group to discover their ways of playing or, in other words, to invent their play instructions.

Children attempted to ask a number of questions as they tackled the games. The following are examples of their questions: *How can we play these games?*; *Where did you get this game?*; *What are we supposed to do with the board?*; *and How do we play using all the game's pieces (paraphernalia)?*

These questions guided the children in designing implied instructions derived from their previous experiences with those educational games to what they have been exposed to in their lives. Through this observation, children represented their ability to investigate as they posed questions and willingly cooperated with others to figure it out. It was clear that children also initiated dialogue and listened to their peers' thoughts and suggestions. Since children deal with the games in unique ways, they use items differently from the game manufacturer's instructions.

The following observations were made regarding the children's subjects:

Children played with the pieces only while neglecting the actual board, in games that contained both boards and objects such as acorn grains, tiles, etc.

Children tried to match each object with its allocated place according to its color while neglecting other items.

Children arranged objects according to their size sequences and compared them accordingly.

Children tried to count the number of stars, circles, and so on, in games that contained cards.

Children used the colored tiles to construct a carpet or to tile a colored floor.

Children arranged objects according to size, color, length, shape, or number of similar items (simple patterns according to one variable).

Although children did not state their play instructions in a clear, explicit, or direct way when approaching any of the given games, it seems that their repertoire of experienced ways of playing guided them during this particular stage.

### *Stage two: guided play*

This stage aims to acquaint the children with the games and their goals. In this stage, teachers play more active roles than child-directed, free play. Teachers were asked to join the games and look for ways to subtly make it more educational and beneficial for children's learning by guiding them in that. By giving children the instructions according to the manufacturer's instructions, teachers

taught children about the features of a new game. They then helped them with more active exploration during the session. While making them acquainted with the games using boards or pieces during paraphernalia sessions, children were asked plenty of questions by teachers like 'what do you think will happen if we do this?' or 'how could we do this?' With appropriate amounts of explanations and described information, children obtained answers to their previous questions that they had made during self-directed play. In addition, all children quickly followed the directions the researchers gave and learned the mathematical concepts based on their understanding. This was a stage of knowing the games and realising their goals.

## Stage three: combination of free play and guided play

This stage is aimed at the following: (1) investigating the types of games that learners play freely, (2) ascertaining whether the learners were able to invent some new games, and (3) discovering the complexity of instructions and how easy or difficult these were to explain.

Interestingly, in this stage, it was noticed that children participants tried to invent their games during the observation. In one of the games, they first counted the sum and then the remainder of the objects. Some of the games consisted of animals such as owls, chickens, or squirrels, some children proposed a colouring activity such as drawing those animals and colouring their feathers. For games that contained cards, similar cards were collected according to the number of items on them. Then attempts were made to find the sum, and totals of the numbers, with cards being placed in ascending order according to the number of items. A number of children drew upon their old repertoire of games to create a new game, such as shape matching, or created new memory games using existing games either containing cards or having shapes (e.g. stars, squares, circles); some even designed more complex patterns consisting of more than one variable such as using both shapes and colours. Indeed, a number of children attempted to recall some previous games they had played and incorporate what they had learned into the new games.

While playing, it was confirmed that children stated and confirmed their instructions within their group play. Each time one of the group members proposed a new way of playing, his group peers became interested and responded directly by starting a discussion about the game, followed by experimental play, assessment, reflection, and, finally, modification of that game. The children also invented their games from scratch. Specifically, they brought a dice and used it to play with geometric shapes one time. For example, if one child got '3' by rolling the dice, he took three triangles. If another child got '4', they took four squares. Their trial culminated in building new geometric constructs using the selected shapes.

During this stage, we found that the children were not interested in continuing playing games if it was not challenging or thought-provoking enough. Instead, they preferred to play challenging games so they could get a chance to invent their own rules, which opened up new horizons for them and enabled them to link their prior experiences in games with new and alternative play approaches to these new games. Through these observations, it was evident that young children utilised these experiences to learn what constructive learning is truly about and benefit themselves as they reveal and express their feelings in a highly positive way.

Results pertaining to research question 2.

The researchers collected data from the children participants' dialogue and responses while observing them playing and from conducting the focus group interviews to answer the second research question: *What are children's attitudes to new approaches in the use of educational games during the two free stages?*

The statements that reflected their attitudes towards play and the frequency of those statements were documented as shown in Table 1.

According to Table 1, all 90 children expressed their interests and affection in the educational games, as reflected in statements 1, 2, 4, and 8. Meanwhile, according to the items such as 3, 7, 13, 14, 16, and 17, it is clear that children recognise the productive benefits of educational games

in that they can help them to develop their thinking and improve their problem-solving skills. They also expressed that educational games are hard to play without knowing the instructions. It can be difficult for them to effectively play such games using all the paraphernalia, a sentiment reflected in statements such as 5 and 12.

To clarify, these statements were inferred from children's responses such as:

| | |
|---|---|
| Ali: | 'I like games. I work with my friends in this game.' |
| Seleen: | 'These games allow us to play together.' |
| Mahmoud: | 'I love my kindergarten; we play together and have nice games.' |
| Nour: | 'These games are exciting; now I'm intelligent, and I think deeply about how to play.' |
| Rami: | 'When playing educational games, we can learn the numbers, counting, and matching between numbers and the game items.' |
| Sahar: | 'We learn the concepts of a few and many, many cubes … .' |
| Jamal: | 'These games allow us to become engineers. I want to be an engineer like my father, and in this game, we designed shapes like engineers.' |
| Muna: | 'Games are interesting; they help us think, become thinkers, and solve problems since we thought about how we may play and test in many ways.' |
| Ahmad: | 'I hope we can play on all our school days.' |
| Shahd: | 'I asked my mother to buy these games for me, but she could not find them. I hope we have such games; these games may be so expensive. ' |

Based on those children's responses, we concluded that those educational games positively affected children's attitudes and learning. Based on how children shared their thoughts on educational games, we strongly believe that self-directed math games empowered young children to perceive their proactive role in developing their cognitive thinking and problem-solving skills.

Results pertaining to research question 3.

Research question 3 examines teachers' perspectives on self-directed mathematical games in their classroom? Two main themes emerged based on the research instruments used in answering this question: (1) teachers' perspectives of educational games and (2) teachers' beliefs regarding children's abilities and learning.

## *Teachers' perspectives of educational games*

To measure the value of educational games, we strived to understand how teachers approached these educational games to support children's learning to the utmost of their ability. Accordingly,

**Table 1.** Children's attitudes towards educational games.

| Number | Statement | Frequency |
|---|---|---|
| 1 | I like to play educational games. | 90 |
| 2 | Educational games are fun | 90 |
| 3 | Educational games help us to be creative | 38 |
| 4 | Educational games are interesting | 87 |
| 5 | Educational games are difficult to understand | 02 |
| 6 | I hope to have all the educational games | 71 |
| 7 | Educational games are very useful to us | 67 |
| 8 | I'm looking forward to playing more educational games | 88 |
| 9 | Educational games are more beautiful than other games | 53 |
| 10 | I like to buy educational games | 82 |
| 11 | I feel that educational games very expensive | 12 |
| 12 | I think that educational games need more time for play | 18 |
| 13 | Educational games help us to think | 79 |
| 14 | Educational games help us to be intelligent | 85 |
| 15 | Educational games encourage us to cooperate with each other | 65 |
| 16 | Educational games develop our memory | 77 |
| 17 | Educational games help us to solve problems | 21 |
| 18 | Educational games help us to organise our ways of thinking | 19 |
| 19 | Educational games help us to think and build like engineers | 26 |
| 20 | Educational games encourage our creative and innovative abilities | 30 |

in this study, six preschool teachers were interviewed individually before and after the game activities. During the interview sessions, they were asked both about the methods they used in educational games within their classes and how they encouraged that they usually experiment with the games themselves first, before introducing the games to their classes with full instructions or, sometimes, modelling the manner of playing in front of the whole group. The children are then given the opportunity to experiment with playing the games by themselves, either individually or in groups.

Before this study, teachers had not provided children with many opportunities to explore the games independently, so children were used to simply following the teacher's instructions instead of being innovative and creative. Accordingly, the researchers encouraged the teachers to play different kinds of games with children in three stages. The teachers expressed their desire to know the instructions for each game before playing, emphasising that it would be easier for them and the children. After this, they were shown some of the videos depicting their children actively playing during the two stages of the games. Lastly, the teachers sought to explore the children's perspectives about the whole process, what they had learned, and to what extent they had found the experiment interesting. Teachers endeavoured to get feedback from their children to assess and modify their tried-and-tested strategies and methods in introducing educational games.

While analyzing the data collected from the teacher's interviews, observations, and reflective journals thematically, the data were categorised into codes and then summarised under the two main themes: teacher beliefs and teacher practices.

The teachers' beliefs were then divided into three subcategories: (1) teachers' beliefs regarding children's abilities, (2) those concerning children's learning methods, and (3) beliefs regarding their roles. The researchers categorised teachers' practices into two subcategories: (1) observing and listening to children and (2) ways of introducing games to children.

### *Teachers' beliefs regarding children's abilities*

According to the interview of six Palestinian teachers, it appeared that teachers used to see their students as passive recipients of knowledge and learning. They used to believe that meaningful play would not occur without teachers' clear instructions, and the children did not have enough capabilities to construct their games for their learning. However, after leading several sessions of self-directed and guided play in the classroom, teachers were able to reveal another image of children themselves to see young children as competent, capable, and natural researchers. They stated that children engaged in cooperation during the three stages of play and showed enormously active participation in exploring based on their development and progress levels. All six teachers were surprised by their children's ability to present their ideas, invent and play new games, express their reflections, and even suggest modifications. Teachers said:

> When I saw my children playing happily, learning mathematical concepts easily and with love, dealing with unfamiliar games, trying to explore the instructions, and inventing their ways of playing, I came to realise that I must give them free time to play and invent their games either before or after giving them the game instructions. Teacher (1)

> I saw my children were delighted after participating in this experiment.

### *Teachers' beliefs concerning children's learning methods*

Teachers who participated in this study used to think that children learn much better when teachers demonstrate how to play educational games. Since they were more used to conventional ways of teaching, they were a little worried about not giving specific instructions for the games at first. Teachers used to believe free play may disrupt children's learning, so they will never meet their learning

goals. However, after conducting this research, teachers stated that children have their ways of reaching their potential using their strengths. It was apparent that children participated in the activities as direct participants or as the ones who created the opportunities for learning and development on their own.

> I recognized that open games are more effective for children's cognitive development than closed ones. In the beginning, I thought that children would face difficulties inventing their games in these kinds of games, but I have noticed that children enjoy playing, thinking, and designing their games. (Teacher 4)

> I was surprised when the children expressed their enjoyment. They even talked about what they experienced while playing and the mathematical concepts they learned, such as finding the summation. This makes me eager to use such games, which I borrowed from the researchers to give other children the chance to experience playing with them. (Teacher 5)

### *Teachers' perceptions of their roles*

Five of the teachers in the experiment perceived that teachers ought to explain to children what must be done, what game instructions should be followed, and even which educational concepts they are expected to grasp. On the other hand, the sixth teacher insisted that children must be exposed to opportunities to discover, infer, solve problems, and assess their learning. As going through each session with different self-directed and guided games, all six teachers were deeply impressed by the responses of the children, who had expressed their excitement about their experiences in playing and inventing educational games. Teachers are convinced that children must be given a chance to explore new concepts and develop their understanding and skills by themselves, communicate with their peers, investigate the validity of suggestions made, propose alternative playing methods, find their reasoning, and modify their methods. All of these factors strongly affected teachers' points of view concerning their roles as facilitators of children's learning. They led them to conclude that they have the responsibility to provide and construct educational activities for children to enhance their mental, cognitive and emotional development.

We realised that through this study, teachers were able to reset their roles as primary supporters for their children. To be specific, to benefit young children from being treated as individuals with their strengths and needs, they learned about 'scaffolding' and how to lead children to engage in their exploration. As a partner or a co-player in the game, teachers learn how to subtly guide children for a more educational and beneficial learning experience and ask thought-provoking questions. Understanding that young children need plenty of opportunities to practice the skills that they have just acquired, we emphasised that teachers must be able to offer a new challenge to their students sometimes. The responses of two teachers are presented here:

> They (the children) told me that these games represent a treasure trove of opportunities to explore and discover new things, and they keep talking about them and their new ways of playing with them. Mohamed, one of my students, said he told his mother that he had discovered new things and wanted to be an engineer. I think this experience is vibrant for children's learning. (Teacher 1)

> They (the children) said that these games helped them to become leaders because they were allowed to discover leadership qualities within themselves. I discovered that I have children who are excellent in mathematics and science. The way they played and their conversations made me believe that learning-based play is more fruitful to their learning than traditional methods. Playing educational games freely increases children's focus on designing their games and instructions and promotes their thinking skills. Teacher 2

## Teacher practices

### *Observing and listening to children*

After having positive experiences with educational games, teachers realised that listening to children's reflections and discussions opens up new windows for them to explore their children's

strengths, remedy their shortcomings, and learn about themselves better. As children examined and played with the games on their own, they learned more about their areas of interest, skills, and knowledge levels and what difficulties they experienced with them. For teachers, listening to children worked as a form of self-assessment by influencing them to modify their future methods and ways of introducing educational games to their classes and even using them as tools for developing children's cognitive thinking and communicative and social abilities.

> I noticed from the videos and conversations between children that exposing them to play stages with these different types of games can improve and develop their mathematical and scientific abilities. They reasoned while dealing with patterns, thinking critically, and solving problems. I was really surprised at how these games have affected my children. (Teacher 3).

> I like how they (the children) cooperated; they would listen to each suggestion and examine their play according to it. They worked as a scientific team that thinks, explores, experiments, assesses, reflects, and modifies. (Teacher 6).

> Frankly, I was happy to hear from my children about their attempts at designing their games. Sameer told me that he had invented a 'memory game'; I asked him to explain that. He said, 'Miss, you know in our class we have the animals' memory game? We could play it with geometric shapes.' I rejoiced at seeing my children so able to reflect their capabilities and knowledge in new situations. (Teacher 5).

### *Ways of introducing games to children*

Through discussion and interview sessions, teachers mentioned that they were able to learn more about innovative and effective ways to introduce educational games to children, which opened up greater prospects for them to be able to probe how young children learn and how they can be directed towards the achievement of learning goals in their play. Four of the teachers experimented with using the two stages of play with different games with the remainder of their children; and confirmed their future intention of embracing this strategy.

> From now on, I will not explain to them (the children) how to play to make it easier for them to open more horizons for creative thinking. Over the next year, I want to develop my teaching methodology for mathematics and science around the use of educational games. (Teacher 5).

> This is the first time I've heard about this classification of games: closed, semi-closed, and open games, and the various stages of play. From this experience, I learned to respect my children's need and to provide them with opportunities to develop and practice their freedom. (Teacher 3).

> I wish I could get such games to use in my classes. The children, I found the children happy during the three stages; they found them fun and interesting. I believe that watching children while playing and listening to their conversations allows us more room for better acquainting ourselves with their personalities and ways of thinking. (Teacher 6)

## Discussion

Children responded to new and unfamiliar educational games during the first stage of self-directed play, trying cooperatively to discover and make decisions about how they could play with them without having formal instructions. This result has something in common with the findings of Fountaine, Liguori, Mozumdar, and Schuna (2011), who indicated that playing leads children to make rational and prudent decisions and aids their understanding of the suggestions proposed by each child and how to function with it. Children used to discuss each proposition and give suggestions for amendments. Furthermore, going along with the idea of Anderson-McNamee and Bailey (2010), we believe that interactive play with other children teaches them to negotiate and solve problems.

In the third stage of a combination of self-directed and guided play, educational games help children's cognitive development. This is because there was a differentiation as they selected the game

to play, figure out what they preferred, corrected the flaws, and reinvented their own rules when they faced difficulties. Fisher (2014) and Lynch (2015) emphasise that play facilitates the development of various children's social, cognitive, mathematical, motor, and linguistic skills. Furthermore, as Najdi and El Sheikh (2012) claimed, we recognised that children developed more positive attitudes toward role play, which is an excellent tool for children's thinking and problem-solving skills. In addition, this study allowed teachers to remind them of the importance of scaffolding so they can reflect on children's needs when they have difficulties playing without clear instructions (Fisher et al. 2011).

Teachers have believed that meaningful play cannot occur without clear directions, and children would lack the ability to play by themselves and construct their games. Moreover, they used to see children that are not cognitively mature enough to play educational games as passive recipients in learning. However, Hirsch-Pasek and Golinkoff (2008) views that they are the 'adults' who can construct play according to their teaching goals and the child's developmental level and that free play improves children's socio-emotional development (Pagani, Fitzpatrick, Archambault & Janosz 2010). Accordingly, after having experienced self-directed play, teachers in Palestinian preschools were astonished by the degree of effective engagement of children in cooperation and their ability to discuss, suggest, invent, modify and reinvent. This experiment greatly impacted the teaching practices of participant teachers in Palestine through close observation and discussion with teachers and children. They expressed that they would like to keep practicing these child-directed educational games in their future teaching practice to reinforce children's learning and keep them proactive learners.

## Conclusions

Having been exposed to three stages of free play, guided play, and combining both, children stepped into new horizons for investigating, discovering, and creating new knowledge. While playing, children learned the following: (1) Mathematical concepts such as *more* and *less*: when they constructed shapes, they said they needed more cubes and blocks to finish them. They found themselves counting in *ascending* or *descending* order when, for example, they arranged items from 1–30 or 30-1, and they needed to match between *numbers* and *numbered* when they played with cards having various numbers of items and cubes. (2) Scientific concepts: these include both primary colours and the secondary colours resulting from mixing different primary colours, together with how different animals are influenced by sunlight (for example, cows are indifferent to sunlight, as opposed to nocturnal creatures such as owls). Scientific questions were asked, such as, 'Do chicks eat the same food as their mothers?' and, 'Why are the legs of some animals taller than others?' (3) Problem solving, such as the way games were approached by the children during the first free-play stage and their paths to creating their instructions.

It was noticed that children interacted and cooperated in constructing their games during the self-directed stage, which became a critical tool for their social development. In addition, they expressed empathy with the animals mentioned in the games, such as owls, who go home before the sun rises, causing the children to wonder where they get their food from. The children constructed their own mathematical and scientific concepts during free play in this study. Considering themselves as engineers during the play, they designed buildings, bridges, and towers. It was observed that their communication skills were developed, and they learned how to pose questions for inquiry, articulate their thoughts, become a good listener to other peers, and cooperate. Consequently, implementing self-directed games in a conventional classroom in Palestine had a great significance in Palestinian early childhood development as contributing to enriching children's play, and we believe self-directed play facilitates the development of a variety of children's social, cognitive, motor, and linguistic skills (Bordova, Germeroth & Leong 2013).

Teachers' perspectives were influenced by their children, who were accustomed to discussing with their teachers during class what they had experienced through play during the three stages

of play. These discussions have impacted teachers' beliefs about children's abilities and ways of learning, along with their roles as facilitators and teaching practices. Teachers gained a better understanding of their children's abilities and learned about the most effective ways of learning and how to utilise educational games. They have acquired deeper insights into children's perspectives and how they support children to their utmost effective learning. This step should be continued to stay focused on current and future teacher education programmes in Palestine. Moreover, educational and training programmes need to support educational games as they put more emphasis on them, so they can make a difference in early childhood education that provokes children's curiosity and creativity.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## ORCID

*Buad Al Khales* http://orcid.org/0000-0002-9433-0646
*Fathi Ihmeideh* http://orcid.org/0000-0001-8164-8121

## References

Abu Riya, M. 2001. "The Impact of Using Computerized Games in The Sixth Grade Students in Acquiring the Four Arithmetic Algorithms." *Studies of Educational Sciences* 28: 164–176.

Akinsola, M. K., and I. A. Animasahun. 2007. "The Effect of Simulation-Games Environment on Students Achievement in And Attitudes to Mathematics in Secondary Schools." *Online Submission* 6 (3): 113–119.

Anderson-McNamee, J. K., and S. J. Bailey. 2010. *The Importance of Play in Early Childhood Development*. Montana State University. http://bright-beginnings-folsom.org/wp-content/uploads/2012/12/The-importance-of-play-in-early-childhood-development-Montana-State-Un

Bjorklund, D. F., and A. K. Gardiner. 2011. "Object Play and Tool Use: Developmental and Evolutionary Perspectives." In *Oxford Handbook of Play*, edited by A. D. Pellegrini, 153–171. Oxford, UK: Oxford University Press.

Bodrova, E., C. Germeroth, and D. J. Leong. 2013. "Play and Self-Regulation: Lessons from Vygotsky." *American Journal of Play* 6 (1): 111.

Bragg, L. A. 2006. "The Impact of Mathematical Games on Learning, Attitudes, and Behaviours." Unpublished doctoral thesis, La Trobe University, Bundoora, Australia.

Byrne, D. 1995. 'Games', *Teaching Oral English*, 101–103 Harlow: Longman Group UK Limited.

Costello, P. J. 2013. *Thinking Skills and Early Childhood Education*. London: Routledge.

Denzin, N., and Y. Lincoln. 2000. *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage Publications.

Erikson, E. H. (1950) 1963. *Childhood and Society*. New York: Norton.

Fisher, G. 2014. *Designing Games for Children: Developmental, Usability, and Design Considerations for Making Games for Kids*. New York: Routledge.

Fisher, K., K. Hirsh-Pasek, R. M. Golinkoff, D. Singer, and L. E. Berk. 2011. "Playing Around in School: Implications for Learning and Educational Policy." In *The Oxford Handbook of Play*, edited by A. Pellegrini, 341–363. New York, NY: Oxford University Press.

Fountaine, C., G. Liguori, A. Mozumdar, and J. Schuna. 2011. "Physical Activity and Screen Time Sedentary Behaviors in College Students." *International Journal of Exercise Science* 4 (2): 102–112.

Gough J. 1999. "Playing Mathematical Games: When is a Game not a Game?" *Australian Primary Mathematics Classroom* 4 (2): 12–15.

Griffiths, R. 1994. "The Excellence of Play." In *Mathematics and Play*, edited by J. Moyles, 145–157. Buckingham, UK: Open University Press.

Hays, R. T. 2005. The Effectiveness of Instructional Games: A Literature Review and Discussion (No. Nawctsd-tr-2005-004). Naval air-warfare center training systems div. Orlando, Fl.

Hindawi, A. 2003. *Play Psychology*. Amman: Dar Haneen Publication.

Hirsh-Pasek, K., and R. Golinkoff. 2008. "Why Play=learning." In *Encyclopedia on Early Childhood Development [online]*, edited by R. E. Tremblay, M. Boivin, and RDeV. Peters. Montreal, Quebec: Centre of Excellence for Early Childhood Development and Strategic Knowledge Cluster on Early Child Development. Available at: http://www.child-encyclopedia.com/documents/Hirsh-Pasek-GolinkoffANGxp.pdf.

Hirsh-Pasek, K., R. M. Golinkoff, L. E. Berk, and D. G. Singer. 2009. *A Mandate for Playful Learning in Preschool: Presenting the Evidence*. New York: Oxford University Press.
Holsti, O. 1969. *Content Analysis for the Social Sciences and Humanities*. Reading, MA: Addison-Wesley.
Kamii, C., Y. Miyakawa, and Y. Kato. 2004. "The Development of Logico-Mathematical Knowledge in a Block-Building Activity at Ages 1–4." *Journal of Research in Childhood Education* 19 (1): 44–57.
Lillard, A. S., M. D. Lerner, E. J. Hopkins, R. A. Dore, E. D. Smith, and C. M. Palmquist. 2013. "The Impact of Pretend Play on Children's Development: A Review of the Evidence." *Psychological Bulletin* 139 (1): 1.
Liu, T. Y., and Y. L. Chu. 2010. "Using Ubiquitous Games in an English Listening and Speaking Course: Impact on Learning Outcomes and Motivation." *Computers & Education* 55 (2): 630–643.
Lynch, M. 2015. "More Play, Please: The Perspective Of Kindergarten Teachers on Play in The Classroom." *American Journal of Play* 7 (3): 347.
Mahmoud, A., and Z. Al-Tunh. 2014. "Using Games to Promote Students' Motivation Fowards Learning English." *Journal of Al-Quds Open University for Educational and Psychological Research and Studies* 2 (5): 11–33.
Monroe, E., and M. Nelson. 2003. "The 'Pits': A Game to Help Develop Skills and Promote Learning." *Australian Primary Mathematics Classroom* 8 (1): 20–23.
Najdi, S., and R. El Sheikh. 2012. "Educational Games: Do They Make a Difference?" *Procedia - Social and Behavioral Sciences* 47: 48–51.
Neuman, S. B., and K. Roskos. 1992. "Literacy Objects as Cultural Tools: Effects on Children's Literacy Behaviors in Play." *Reading Research Quarterly* 27 (3): 203–225.
Pagani, L. S., C. Fitzpatrick, I. Archambault, and M. Janosz. 2010. "School Readiness and Later Achievement: A French Canadian Replication and Extension." *Developmental Psychology* 46 (5): 984.
Piaget, J. 1963. *Psihologija Inteligencije*. Beograd: Nolit.
Play and Playground Encyclopedia. 2010. Accessed July 23, 2020: 22:39. https://www.pgpedia.com/f/free-play.
Prensky, M. 2001. "Fun, Play and Games: What Makes Games Engaging?" *Digital Game-Based Learning* 5: 1–05.
Prensky, M. 2003. "Digital Game-Based Learning." *Computers in Entertainment (CIE)* 1 (1): 21–21.
Rabiner, D. L., J. Godwin, and K. A. Dodge. 2016. "Predicting Academic Achievement and Attainment: The Contribution of Early Academic Skills, Attention Difficulties, and Social Competence." *School Psychology Review* 45 (2): 250–267.
Reynolds, A., S. Ou, and J. Topitzes. 2004. "Paths of Effects of Early Childhood Intervention on Educational Attainment and Delinquency: A Confirmatory Analysis of the Chicago Child-Parent Centers." *Child Development* 75 (5): 1299–1328.
Romano, E., L. Babchishin, L. S. Pagani, and D. Kohen. 2010. "School Readiness and Later Achievement: Replication and Extension Using a Nationwide Canadian Survey." *Developmental Psychology* 46 (5): 995.
Seale, C., G. Gobo, J. Gubrium, and D. Silverman. 2006. *Qualitative Research Practice.* London: Sage.
Singer, D. G., and J. L. Singer. 1990. *The House of Make-Believe: Children's Play and the Developing Imagination*. Cambridge, MA: Harvard University Press.
Udosen, A. E., and U. S. Ekpo. 2016. "Instructional Games: Implications for Curriculum and Instruction." *Online Journal of Education and Curriculum Studies* 1 (1): 39–55.
Vygotsky, L. (1933) 1978. *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.
Vygotsky, L. S. 1977. *Mind in Society: The Development of Higher Psychological Processes*. Vol. 14. London: Havard University Press.
Vygotsky, L. S. 1978. *Mind in Society*. London: Harvard University Press.
Vygotsky, L. S. 1998. "The Problem of Age." *The Collected Works of LS Vygotsky* 5: 187–206.
Vygotsky, L. S. 1999. "Tool and Sign in the Development of the Child." *The Collected Works of LS Vygotsky* 6: 3–68.
Weisberg, D. S., K. Hirsh-Pasek, and R. M. Golinkoff. 2013. "Guided Play: Where Curricular Goals Meet a Playful Pedagogy." *Mind, Brain, and Education* 7 (2): 104–112.
White, R. E. 2012. *The Power of Play: A Research Summary on Play and Learning*. Rochester: Minnesota Children's Museum.