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Designing Playful Learning by Using Educational Board Game for Children In The Age Range of 7-12: (A Case Study: Recycling and Waste Separation Education Board Game)

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ABSTRACT

Due to a progressive deterioration of our planet and its resources, environmental education has become important and children are required to understand environmental issues at an early ages. So, they can cultivate the positive changes in the future. Over the past decade, many new evaluation methods have developed for evaluating user experience with children, but the results of these studies have tended to be reported in the isolation of other techniques. This paper use different methods include focus group, Fun toolkit, and game checklist for designing board game about recycling. First we sketch our primary ideas and then we design our first board game prototype and evaluate it by focus group in order to gather children opinion and then redesign it for further evaluation, after that we select two computer game about recycling, in this part 20 children participate in evaluating two games by fun toolkit. The experiences of each were captured by using 4 evaluation instrument in fun toolkit including: smileyometer, the fun sorter, the again-again, This or That method, The results showed that the Fun Toolkit and This or That method showed similar results and were able to establish a preference for one game over the other. However, there were some inconsistencies between the results of individual tools in the Fun toolkit and some of the constructs being measured in the This or That method. Further research will try to identify any ordering effects of each method and redundancies of the questions. Result of this part were used in promoting our game according to the result of fun toolkit. Game checklist was also used in order to redesign the different parts of the game, consequently, we design a board game of these young children's responses. Which can be used in both home and school area.

KEYWORDS
Board game, fun toolkit, children psychology, educational game, environmental education, recycle game

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Environmental Education and Children

Literature reviews in Environmental education provide a lot of information in this area which can be summarizing in following lines, As Cork *et al.* (2006, p. 2) argue, *'Biodiversity is of incalculable value to this and future generations'*. Protecting the world's unique landscapes, ecosystems and species is, therefore, a major challenge today. Also, Maria Goncharova, (2012) explained that Environmental protection is the first human task and perhaps the most important human responsibility. Because nowadays environmental pollution has become one of the human disasters. According to Takala (1991) explained that any potential for a significant shift towards environmental consciousness is hampered by policy-makers who are initially and foremost preoccupied with rapid economic growth – an idea mostly conflicting with sustainability and cautious treatment of the planet and its resources. Moreover, Domka, (2005), has stated that "necessary changes in people's attitude to the environment can occur as a result of general education, carried out on a mass scale, available for all social groups and generations" Gajus-Lankamer (2004) explained that Environmental education is a prerequisite for environmental awareness to transpire; yet it is still not ubiquitously offered and practiced on a global scale, being the privilege of school curriculums only in economically developed nations.In fact, as Stoll-Kleemann & Welp (2008) has declared education and awareness raising are considered the most influential factors for successful environment protection.

One possible definition of Environmental education is the one provided in the Tbilisi declaration as *'education utilizing the findings of science and technology (that) should play a leading role in creating awareness and a better understanding of environmental problems. It must foster positive patterns of conduct towards the environment and nations' use of their resources'* (UNESCO-UNEP 1978, p.1).

Over the last decade the UNESCO-UNEP International Environmental Education Programme (IEEP) has developed the Environmental Education Series focussing on the incorporation of EE into primary and secondary curricula, teacher education, technical and vocational education and non-formal education. Environmental education emphasizes the teaching of the holistic nature of the environment through interdisciplinary and problem-solving approaches. This has to start as early in education as possible. The primary school is the natural place to introduce children to environmental education, since at this level they instinctively have a holistic view of the environment; they have not yet been trained to compartmentalize their learning into separate subjects as they will have to do in secondary and higher education. Palmer (1998) presented an integrated model of EE that reflects the relationship between education *about* the environment, *for* the environment, and *in/from* the environment. At the center of this model are the learning processes and curriculum elements driven by knowledge and understanding, concepts, skills and attitudes. This model, according to Palmer requires appropriate tasks that provide students with "experiences in problem-solving, decision-making and participation in decisions concerning the environment with considerations based on ecological, political, economic, social, aesthetic and ethical aspects" Leeming, Dwyer, Porter and Cobern (1993) conducted a critical review of 34 environmental education studies published from 1974 to 1993. The majority of the studies reviewed focused on changes in attitude, knowledge, or both. Only 5 of the 34 studies measured changes in behavior. The authors expressed regret in that, "it is ultimately

behavior change that is required to preserve environmental quality" (p.19). Another conclusion of this review was that none of the studies addressed environmental education strategies for getting children to encourage others (e.g., their parents) to change environmentally relevant behavior. Rovira (2000) presented an evaluation of students and parents, which concluded that transmission of environmental consciousness to families through students might be doubtful since environmental consciousness is influenced by social factors such as social position, age, and level of education.

According to our studies, there is a lack of education of proper recycling management for the youth in the elementary school system. Most elementary schools have a recycling program and enough recycling bins. Despite this, about 80% of the items thrown in trash cans at elementary schools can actually be recycled. The problem is that there is a lack of education of proper recycling management in elementary schools. The youth is responsible for the planet's future, and if they do not care about the environment now, they will not care about it when they become adults. Thus it is crucial to educate children so they can contribute to greener communities, literature review show that some Asian countries for example Most Japanese cities and Singapore have developed good systems for educating people (mainly children) about hygiene, with some attention to solid wastes. Japanese cities have the resources and trained teachers necessary to prepare appropriate lessons, attractive booklets, posters and diagrams to illustrate waste problems and the benefits of separation of clean wastes. One effective component of Japanese schools' curriculum is field trips to waste management facilities; for younger children, garbage trucks are brought to the schools to demonstrate waste collection. Singapore employs sociologists and psychologists to assist in the preparation of educational programs both for schools and the general public. Furedy (1990a) has stated that the state system of waste recovery, organized by the Ministry of Commerce reinforces values about recycling. Most other cities do nothing interactive in public education. Even basic hygiene may not be taught in many Indian schools. These are a long way from being able to address waste issues through the curriculum; teacher training would be necessary first.

Game and Environmental Learning

Furedy (1990a) has explained that where there is explicit public education, it is predominantly directed to children. The reasoning is that children are a large proportion of the population, that they are the future householders and decision-makers, that their values are easily influenced. How will the education of children affect current waste problems? It is argued that children will take hygienic practices and ideas about proper waste disposal and recycling, into their homes. Whether children do influence adult behavior, and whether they retain the values and behaviors incorporated in lessons of this kind has not been researched for these cities. In reality, the use of the school system is the easiest way to begin with public education.The education of children in appropriate waste behavior is certainly an essential component of any society's effort to effect change, but unless the school lessens are linked to home and community life in some way, their impact may be minimal. Furthermore, in poor cities, large numbers of children, and especially pavement dwellers, do not attend school; so schools programs must be matched with non-formal teaching, and this entails engaging charitable

organizations in solid waste issues, since they are doing most of the non-formal education.

Psychology Of Play

Pioneering developmental psychologist Lev Vygotsky (1962) thought that play is the leading source of development in children. Many other psychologists talked about the advantages of playing and playfulness such as Rieber's (1996) research led him to conclude that play has four attributes: it is usually voluntary, it holds intrinsic motivation (the act itself is enjoyable), it involves active engagement, and it contains a make-believe quality. Amory et al. (1999) reviewed work of several research studies to conclude that play performs an important role in childhood, "specifically as a voluntary, intrinsically motivating force." Games are thought to fill the role of a self-motivating and rewarding activity — a "universally accepted mode of learning." As Pausewang (1997) notes, games can contribute to the development of cognitive, psychomotor, emotional, creative, and social skills. Baer (1995) concludes that *'play is the best form of learning'*.

Defining Games and Simulations

(Norman K. Lowe, 1988) explains that Toys and games are synonymous with PLAY. Play is also seen as a means of working off aggression; as a means of learning basic skills of survival (as is also observable in the animal kingdom); as a means of learning social behavior (competitive and co-operative games), as well as the commonly accepted means of relaxation. Although the majority of schools in the less developed countries are not likely to have computers in the foreseeable future the schoolchildren in these schools can enjoy their early experiences in learning science and technology through toys and games. Fritz (1991) explains that Games have been played for thousands of years in practically all parts of the world. Already in antique times, games were used as educational tools for children. Games are, by a widely accepted, basic definition given by Abt (1968), 'any contest (play) among adversaries (players) operating under constraints (rules) for an objective (winning)'. Games are often mentioned according to Guetzkow (1963) and Ellington et al. (1998), in the same context as simulations. Simulations are generally defined as 'operating representations of central features of reality'

Game-Based Learning

Vítor Belim et al (2014) explain that Game-based learning refers to the use of games to encourage learning. This can be through the use of 'serious games' inside and outside of the classroom to benefit education, or through the use of non-educational games in an educational manner 'Serious games' are ones that have been specifically designed with an educational purpose in mind. They may have clear learning objectives and have been developed to support learning in specific subjects, usually English, math and science. Gordon (1972) also explains that firstly games In the 1950s were introduced as a teaching method in business management training. Galarneau (2005) states that During the 1960s and 1970s, games spread to the main branches of education and social sciences.

Strengths of Educational Games

Thatcher, D. C. (1990) has stated that the idea of using games to engage students in the process of active learning is not new. Quinn and Iverson argued

that students "need to be engaged more and to be put at the centre of the learning experience to change from 'passive vessel' to 'active participant'" As (Gordon 1972, Buland 1995, Pausewang 1997, Wideman *et al.* 2007, Wilson *et al.* 2009) have explained that 'active participant' increase the learner's comprehension of concepts, to improve interdisciplinary thinking, to develop interpersonal and other skills, and to enhance learning experiences in general. Caillois, R. (1961) stated that While some games are competitive in nature, others may simply allow students to work together as a class to solve a general problem where no one "wins" or "loses." In "All Play and No Work," MacKenty (2006) states that, "it's the act of problem solving that makes games so engaging devoid of challenge or risk of failure, games really aren't all that much fun". Schaller (2006) states that iteration, or repetition of the process, is critical to "support the learning process by encouraging experimentation, hypothesis testing and synthesis" which are all higher level thinking skills. In their recent review of learning and games, Moving Learning Games Forward, Klopfer, Osterweil, and Salen (2009) categorize different types of learning that are possible with games. For example, games can be effective at transmitting content (from history to urban planning), at training on specific skills (from literacy to piloting planes), at developing systems thinking (how changing one element affects relationships as a whole), and at enabling the creation of artifacts (from videos to software code).

Games Boards as Edutainment Tool

Casbergue R et al (1998) have stated that Games as edutainment include board, video and card games, which realize different educational goals that can all be used in an educational environment. Edutainment games can be used to help children to acquire skills, educate them on subjects, reinforce knowledge, and increase beliefs. Schroeder CC.(1993) has states that However, there is not a significant differentiation between the computer- or classroom-based approaches. The aim of both traditional games (such as card games and board games), or computer games, is to have fun while learning. Huizinga, J. (1950) explains that One way of learning is through playing board game, which is different from free play in that players must follow game rules with opponent players. So in addition to skills, children can learn social skills like how to interact with peers, how to follow game rules,and how to apprehended others' perspectives. Related researches have demonstrated diverse social behavior as children played board games.Existing board games are, for the most part, competitive games in which a few win and the majority loses, such as the famous Monopoly. Basically, they stimulate negative values like violence, greed, and pride. In a certain way, contemporary games reflect the values of the predatory and consumerist society in which we live.The majority of us have diverse experiences with competitive games. However, rarely do we have the chance to participate in cooperative games in a systematic manner. Cooperative board games are games that aim to awaken aspects of cooperation and solidarity within participants. They are an excellent resource to exercise teamwork and the passive solution of conflicts. They may also be used to reunite friends and family around a creative and vibrant enjoyment.

Harris, (2003) explains some outlining tips for successful board games:

- Be creative—Think out of the box
- Make it a learning tool
- Give it a professional look

• Develop a good set of rules

Millians (1999) suggested that educational games, and board games in particular, are appropriate for the cognitive level of elementary school students. Corbeil, (1999) states that Educational games provide a playful and exploratory means for learning in children. Moreover, educational games can be implemented both in and out of class. Lennon (1994; 1996a) they can also become a learner-initiated activity requiring little or no assistance from teachers. Finally, they can be used to involve both teachers and students. Board game are categorized Group games contribute to children's self-regulation or autonomy by providing a context in which they can voluntarily accept and submit to rules. In daily life, in contrast, they usually do not have the option of choosing to accept and follow rules.Group games is one such type of activity in which rules are not so sacred, and children can find out for themselves what happens when they fail to follow game rules.

According to Rheta DeVries (1987) a competitive game is especially conducive to moral development because opposed intentions must be coordinated within a broader context of cooperation. That is, competition can only exist when players cooperate in agreeing on the rules, enforcing them, abiding by them, and accepting their consequences even when unfavorable to themselves. The game cannot occur unless players cooperate by coordinating their points of view. in one study done by Kee-Young Choi (2005) Which explored Korean and American children's play behaviors during board games in a kindergarten classroom using an ethnographic approach. The results of this study were as follows; first, board games functioned as play–oriented activities in Korea. But in America board games functioned as learning-oriented activities rather than as play-oriented ones in that classroom. Second, there were some differences in children's board game commencement behavior, observation behavior of board game rules,winning strategies, and behavior at game termination, and board game behavior by demographic characteristics but there were common featuresalso found between two countries. Brady et al (1983) and Shapira et al (1971) explain that Board game play is different from free play in that players must follow game rules with opponent players. So in addition to skills, children can learn social skills like how to interact with peers, how to follow game rules, and how to apprehended others' perspectives. Related researches have demonstrated diverse social behavior as children played board games.

In our research we combines research in child development & educational strategies with environmentally related issues into a board game about recycling that promotes active learning. Data for the study is gathered in a qualitative and quantities manner, doing explanatory design with children and testing various prototype of a recycling education game that combines various styles of play will then be designed based on the gathered data. The game aims to explore concepts, scenarios, and strategies of recycling in order to encouraging children to become active participants in preserving the planet and promoting environmentally responsible behavior like recycling.

Material and Method

Children Involvement in Design Process

The way in which children are asked questions in surveys impacts on the reliability of the response. Janet C Read et al (2006) have reported that "*There is a strong acquiescence response bias in children: children tend to say 'yes',*

irrespective of the question or what they think about it." Since the eighties, adults have started to understand children's capability to supply valuable contributions to research and their right to be directly approached when their behavior and opinions are being studied. This new approach to research with children has been referred to as the 'new sociology of childhood', initiated by the Children's Rights Movement and inspired by the 1989 UN Charter that highlighted that "children have valid and valuable views and opinions that deserve to be elicited and taken seriously"

Marton, F., & Booth, S. (1997) have stated that the type of product in the test influences the selection procedure of the children. Children, older than 14 years of age, will likely behave as adults in a testing situation and should be behaved accordingly.

1. Preschool (2 to 5 years old): Children in this age range have a lower concentration period and would not be able to focus constantly on one object. They may try to impress the adults by showing what they can do on computers without any help. Children in this age group are too young to clearly show their satisfaction levels.
2. Elementary School (6 to 10 years old): Children in this age range are involved in software usability testing. They are able to follow a task with a higher attention span. They can describe their satisfaction levels properly.
3. Secondary School (11 to 14 years old): This group is the easiest and mostly used in usability testing. They may be somewhat familiar with the use of the computers. They may be able to "think aloud" during the session, while others may be self-conscious.

Evaluation Method

Gallenstein, N. L., (2014) explains that according to Read and McFarlane the Smileyometer may be right and suitable for measuring the fun in children with more than 9 years of age. My own experience indicates that despite their limitations, the tools like the Smileyometer may be useful for children with seven years old and more. However, for younger children, this does not seem to be the most effective method. Some methods such as diary studies, think-aloud methods, surveys, and Wizard of Oz techniques have been used with older children. Read and Markopoulus also described the Fun Toolkit - a survey method to get children's opinion on technology.

Revised Fun Toolkit

Janet C Read & Stuart MacFarlane, (2006)have explained that, the Fun Toolkit is comprised of four special tools, a Smileyometer, a Funometer, an Again – Again Table, and a Fun Sorter and was carefully designed to be Fun, Fast, and Fair. The Smileyometer is shown in Figure 2 and is a discrete Likert type scale. Some researchers have used other methods like talk aloud (adapted from think aloud) and observation when involving young children as evaluators.

The Smileyometer

Prosser. J. & Burke. C., (2011) and *Shahadat. Hossain khan, (2014) have explained that* Surveys based on face or smiley scales have a long tradition in medical research for measuring pain or anxiety, in psycho-social investigations

for relationship assessment and in marketing research. In 2001, Read and her colleagues were inspired by these smiley scales, and introduced the Smileyometer in the domain of child–computer interaction. The Smileyometer measures how good the product experience was on a simple scale with smiley faces, as illustrated in Fig. 1. The Smileyometer belongs to the family of 5-point Likert scales. It is based on Visual Analogue Scales (VAS) and uses a 1-5 Likert scale and pictorial representations that can help children to identify their feelings or opinions, The Smileyometer features are easy and quick to complete and requires limited reading and no writing ability. When using the Smileyometer in comparative product evaluations, a separate Smileyometer scale should be presented for each alternative that is evaluated. Petros Lamerasa (2011) has explained that The Smileyometer is usually used before and after the children's interaction with the technology. The rationale behind using it before is that it can measure their expectations, whilst using it afterwards, it is assumed that the child is reporting experienced fun.

Figure 1. Smilyometer rating scale

The Fun Sorter

Prosser. J. and Burke. C., (2011) have explained that It is a tool used to compare a set of related technologies or products. It is based on a repertory grid and made up of n+ 1 columns (where n is the number of items being compared), and m+1 rows (where m is the number of constructs being used). There are different ways to fulfill the Fun Sorter. First, the children interpret the construct then write a description of the technology in blank spaces. But for children with poor reading and writing abilities, they place picture cards (pre-prepared) on an empty grid after interpreting the construct. *Eszter Tóth and Alenka Poplin, (2013)* have explained that this tool in figure 2 is the most challenging because the children need to position and rank items to the construct. Its advantage is that no writing is required. Besides, it is fast and fun to complete especially when stick cards are used. But the intention of the Fun Sorter is to record a children's opinions of the technology or activity, to obtain a measure of the child's engagement.

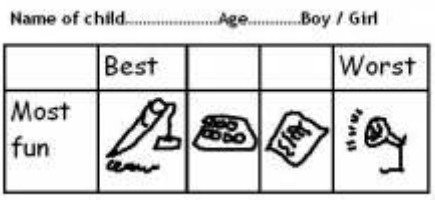


Figure 2. Fun sorter

The Again-Again Table

Lamerasa. Petros, Levyb. Philippa, Paraskakisa. Iraklis and Webberb.Sheila, (2011) have explained that It is a simple table consists of four columns and n + 1 rows (where n is the number of activities under comparison). Child needs to tick either 'yes', 'maybe', or 'no' for each activity or product. The table should be presented in a single sheet after the children have experienced all the technologies. This tool in figure 3 is the most useful if three or more products or activities are being compared. This table is easy and quick to complete, no writing activity involved, and only has one question to be answered, "Do you want to do it again"? Thus, this tool is very suitable to younger children.

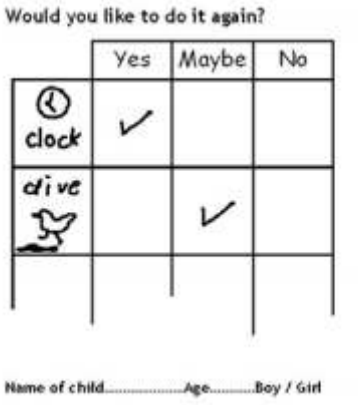


Figure 3. A completed Again-Again table

Method and Material

In this article we first evaluated two computer games about recycling (Figure4) which were designed for children by Fun toolkit, after that we extract main factors for designing new game board for children aged 8-12 years old. The study followed a within-subject research design. The main procedure is consisted of the following steps: (see also Table 1).

Figure 4. Matching game on the left (a), clean town game on the right (b).

Table 1. Experiment process

Step 1	Rapport building
Step 2	Pre smileyometer (1st game)
Step 3	Game play (1st game)
Step 4	Post smileyometer (1st game)
Step 5	Pre smileyometer (2nd game)
Step 6	Game play (2nd game)
Step 7	Post smileyometer (2nd game)
Step 8	Fun toolkit

Data Treatment

In the following section, the data treatment for the reliability and validity testing will be explained. The results for the Fun Toolkit and This or That method are initially presented by a comparative analysis of the reliability of the methods.

Fun Toolkit analysis: Each of the 20 children completed the Smileyometer before and after they played each of the two games and the results of the descriptive statistics that includes a number, mean, standard deviation, minimum and maximum level are presented in Table 1.

Table 2. Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Before- clean town	20	3.80	1.196	1	5
Before- matching game	20	4.15	1.226	1	5
after_clean town	20	4.10	1.165	1	5
after_matching game	20	4.05	.826	3	5

The following table shows the number, average and negative rating (after <before), Positive rating (after> before) and nodes (after = before) in two games.

Table 3. Ranks

		N	Mean Rank	Sum of Ranks
after_clean town - before_clean town	Negative Ranks	4[a]	6.00	24.00
	Positive Ranks	8[b]	6.75	54.00
	Ties	8[c]		
	Total	20		
after_matching - before_matching	Negative Ranks	9[d]	7.83	70.50
	Positive Ranks	6[e]	8.25	49.50
	Ties	5[f]		
	Total	20		

a. after_clean town < before_clean town
b. after_clean town > before_clean town
c. after_clean town = before_clean town
d. after_matching game< before_matching game
e. after_matching game > before_matching game
f. after_matchig game = before_jmatching game

Table 5. Test Statistics[a]

	after_clean town - before_clean town	after_matching game - before_matching game
Z	-1.222[b]	-.619[c]
Asymp. Sig. (2-tailed)	.222	.536

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.
c. Based on positive ranks.

In Wilcoxon test results, the null hypothesis has been accepted, (p-value> 0.05) indicates that there is no significant differences between the variances of the two samples.

A Shapiro–Wilk normality test was also calculated on the Smileyometer variables, resulting in significant values ($p < .001$), clearly indicates that the distributions, for the *matching game*-values and *clean town,* were not normal.(for before playing clean town game data: n = 20, Mean = 3.8, SD = 1.1964860832322377,W = 0.864797781364006, (p=0.01) = 0.8679999709129333, (p=0.05) = 0.9049999713897705, (p=0.10) = 0.9200000166893005) and (for after playing game data: n = 20, Mean = 4.050000000000001, SD = 1.1459310165698642, W = 0.8015903026410081, (p=0.01) = 0.8679999709129333, (p=0.05) = 0.9049999713897705, (p=0.10) = 0.9200000166893005) and (for before playing matching game data's: n = 20, Mean = 4.15, SD = 1.22581873821025, W

= 0.7283222329228226, (p=0.01) = 0.8679999709129333, (p=0.05) = 0.9049999713897705, (p=0.10) = 0.9200000166893005) and (for after playing matching game data's: n = 20, Mean = 4.050000000000001, SD = 0.8255779474818964, W = 0.8027884385374255, (p=0.01) = 0.8679999709129333, (p=0.05) = 0.9049999713897705, (p=0.10) = 0.9200000166893005)

The results for the Again-Again table are shown in Table 6 below.

Table 6. The results for the Again-Again table

	yes	Maybe	no
Clean town	11	5	4
Matching game	10	7	3

The results shows that the majority of children preferred to game the Matching game. Also, the differences aren't significant which are shown in following tables.

Mann-Whitney U-Tests results:

Table 7. Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Rank	40	1.40	.709	0	2
Type of game	40	1.50	.506	1	2

The above table shows the descriptive statistical data, including the number, mean, standard deviation, minimum and maximum level.

Table 8. Ranks

	Type of game	N	Mean Rank	Sum of Ranks
Rank	Clean town	20	20.23	404.50
	matching	20	20.78	415.50
	Total	40		

In Table (8) both games are examined separately. It includes the average and rank of them.

Table 9. Test Statistics[a]

	Rank
Mann-Whitney U	194.500
Wilcoxon W	404.500
Z	-.165
Asymp. Sig. (2-tailed)	.869
Exact Sig. [2*(1-tailed Sig.)]	.883[b]

a. Grouping Variable: Type of game
b. Not corrected for ties.

The Mann-Whitney test is equal to 194.5 and its p-value is equal to 0.883. Since the p-value> 0.05, then the null hypothesis is accepted that means these two games are not significantly different from each other.

The Fun Sorter looked at two constructs most fun and easiest to play and the results are shown in Table 3.

Table 10. The Fun Sorter

	Clean town	Matching game
Most fun	10	9
Most easy	9	11

In line with the other results reported for the Fun Toolkit, the Fun Sorter identified a preference for the Matching game as the easiest, and the clean town as the funniest. Also, the differences are significant.

Table 11. Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Clean town_fun	20	.50	.513	0	1
Clean town_easy	20	.45	.510	0	1
Matching_fun	20	.50	.513	0	1
matching_easy	20	.55	.510	0	1

The table (11) shows the descriptive statistics of the city and puzzle games for both fun and easy constructs.

Table 12. Ranks

	Mean Rank
Clean town_fun	2.50
Clean town_easy	2.40
matching_fun	2.50
matching_easy	2.60

The table (12) shows the descriptive statistics of the clean town and matching games for both fun and easy constructs.

Table 13. Test Statistics[a]

N	20
Chi-Square	.300
Df	3
Asymp. Sig.	.960

a. Friedman Test

The above table summarizes the information, including the Friedman test statistic and p-value. Based on the above information, the test is not significant, it means there are no significant differences between the four available modes.

This or That results: The results of each five constructs asked by using the This or That method is displayed in Table 4.

Table 14. The results of this or that method

	Clean town game	Matching game
Most fun	11	10
Receive as a birthday present	11	7
Take home	16	6
Play again	11	9
Little bit stupid	11	9

For each of the 5 constructs, it is obvious that the clean town game was preferred by the children. A total score was calculated based upon the responses to each of the questions.

Comparing the methods:

Between the two methods, there were a number of constructs that were identical, for example the Fun sorter and the first question in this or that method were trying to determine which game was most fun. Analysis was thus performed on the constructs that matched between the methods. For the construct of fun, as analyzed through the first question in the fun sorter and this or that method, there was a consistency in response of 55%, in that 11 of 20 children responses matched between the two tools.

In the This or That method, the fourth question asked the children which they would like to play again, this was compared with the results from the Again-Again table. The Again-Again table allowed the children to comment on each of the games, thus allowing the children to state that they would like to play both games again, whilst This or That method was a forced response whereby the child had to state a preference for one game over the other. The results for this construct revealed a match in 11 cases of 20 (55% match). In total, using this or that method, 9 children stated that they would like to play one game again, though in the Again-Again table, they showed only stated maybe.

And there were 14 children (70%) who reported a preference for the matching game across all the tools.

After that we extract the most important features of both game and implement them in our final design game especially according to our result gained from fun toolkit:

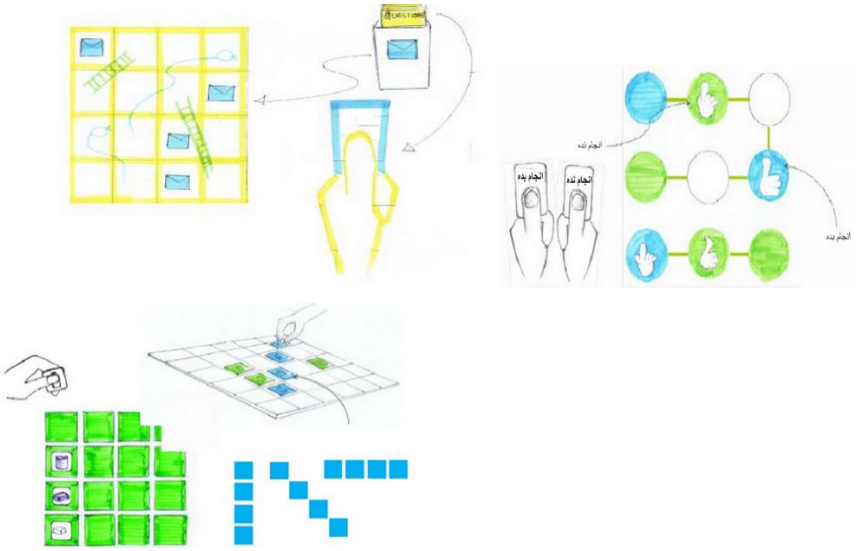
Clean town game features:

- Encouraging players to find garbage
- Playing location is town
- Simple rules
- player should move game character by up-down-left-right bottom

Matching game:

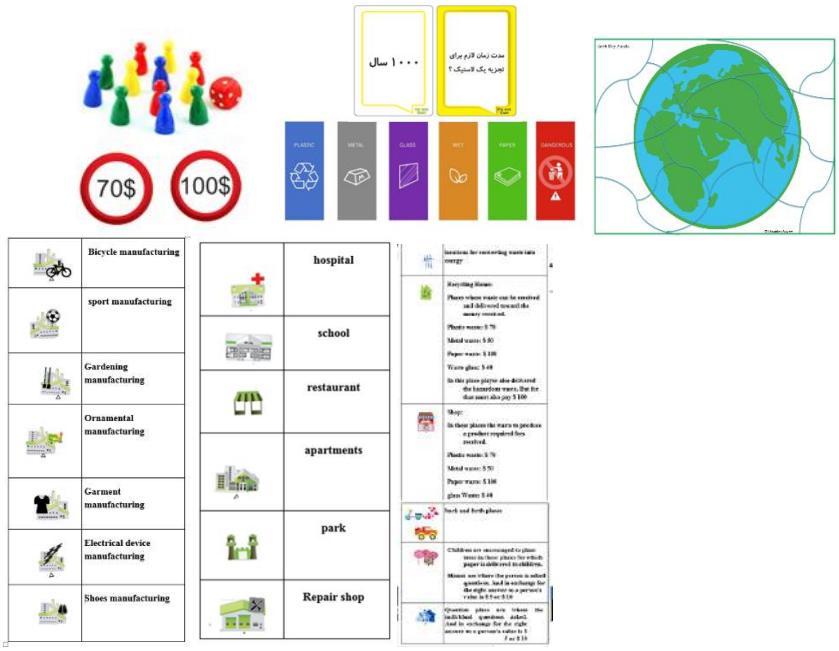
- finding traches
- putting each trash in related recycle bin

In order to design our board game we use several methods, in our first phase of design process we sketch our primary ideas and then promote it into first board game prototype:



Based on the basic ideas we evaluate them from fun, educational, cooperative perspective, after that we modeled and prototyped our first game board with the theme of recycling and garbage value perception which is shown in Figure 2.

Game Instruments:



Game structure:

Played by four individuals

You win this game by being the first player as soon as you made your puzzle.

There are a few ways to earn victory points. The most common way is to gain the most garbage cards during the game and denote it to the manufacture places which are place in different part of the game and take puzzle parts in turn for making your puzzle as soon as possible.

On your turn, the first thing you always do is roll these dice. The number that comes up on the dice corresponds to a tile on the board.

Once you've rolled the dice on your turn, you have the opportunity to use your property cards to buy garbage card. You can also try to trade resources with other players, or you can earn money regarding answer questions correctly.

The game ends as soon as someone has completed his puzzle.

Doing Focus Groups with Children:

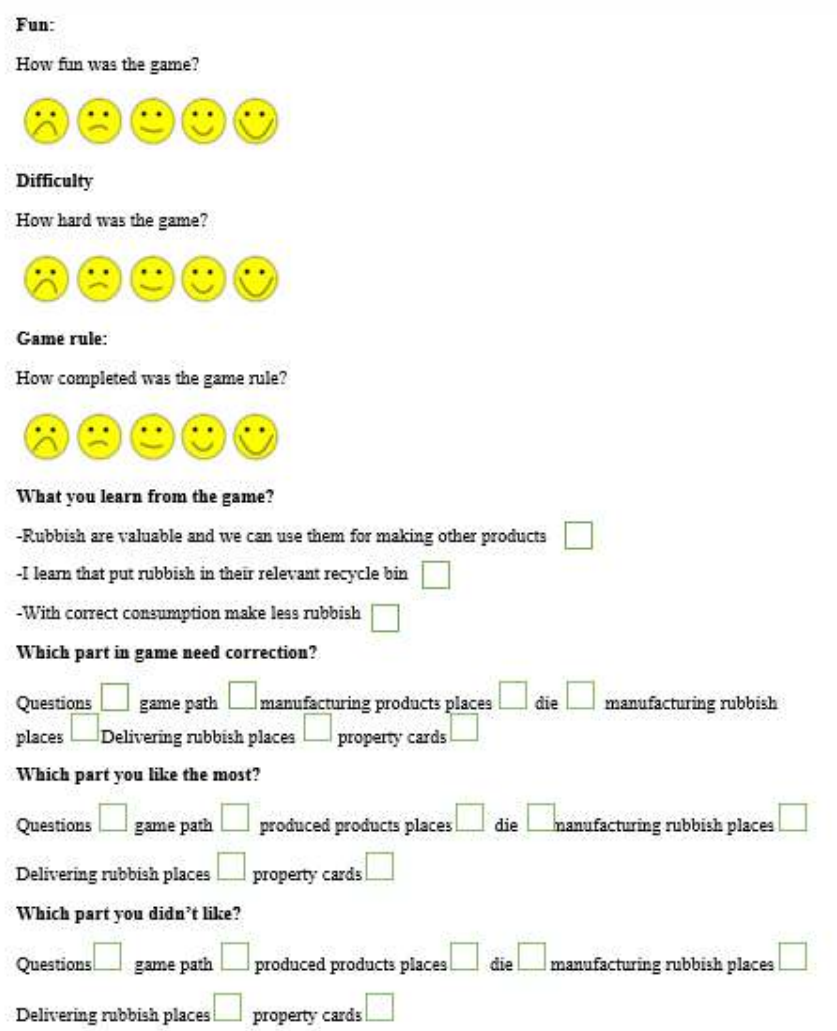
Focus Group is a type of in-depth interview accomplished in a group, whose meetings present characteristics defined with respect to the proposal, size, composition, and interview procedures. The focus or object of analysis is the interaction inside the group. The participants influence each other through their answers to the ideas and contributions during the discussion. The moderator stimulates discussion with comments or subjects. The fundamental data produced by this technique are the transcrips of the group discussions and the moderator's reflections and annotations.46

In our focus group part we ask 10 children age of 7-12 to play game prototype and collect their opinion about the game, after that we consider their opinion in

designing game. Game Parts that according to children opinion need correlation were:

- Board background color
- Symbol graphics
- Make product instead of puzzle for being winner 47.

After that we use game checklist about our game in order to evaluate diffrent part of game from children viespoint

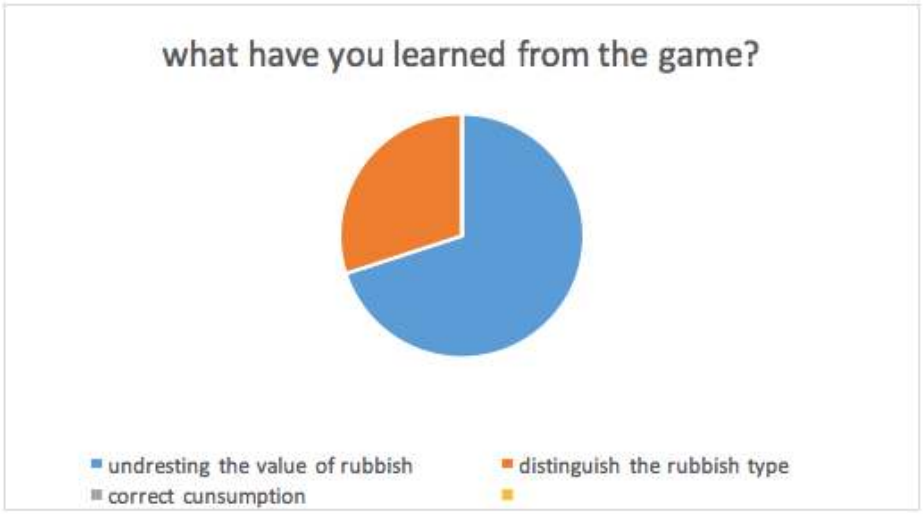


According to above information Difficulty coefficient of variation can be calculated in the form of $CV = \frac{\sigma}{\mu} * 100 = \frac{0.527}{3.5} * 100 = 15$

And the coefficient of variation about clarity game rules is equal to $CV = \frac{\sigma}{\mu} * 100 = \frac{0.850}{3.5} * 100 = 24$

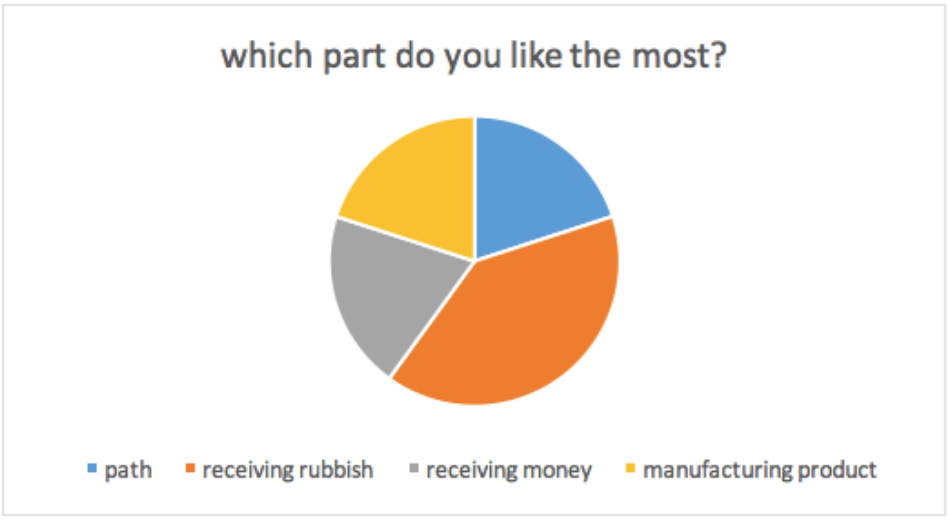
In the first part they have been compared due to scattering coefficient of variation and in the next part the differences between difficulties and clarity of game rules have been compared. So game rules clarity is $\frac{24}{15} = 1.6$ times scatter than difficulty.

What have you learned from the game?

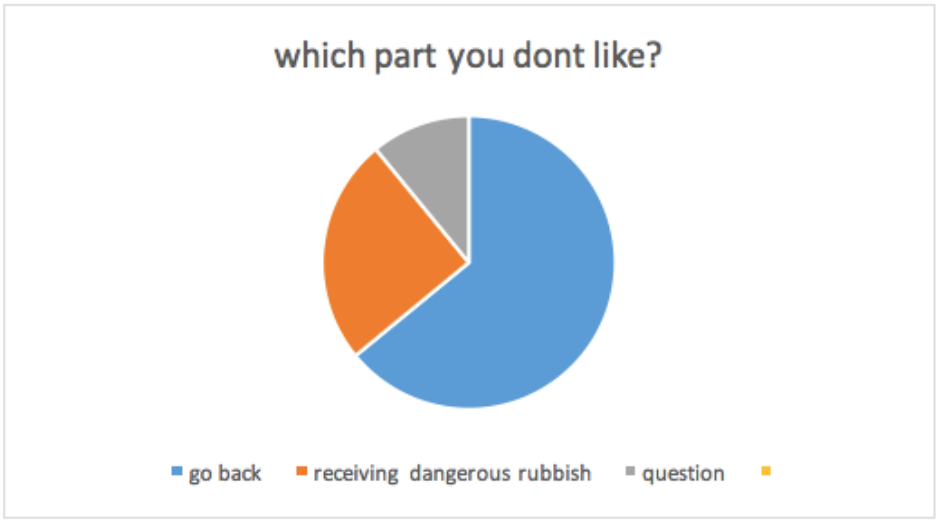


Which part of game need correction?

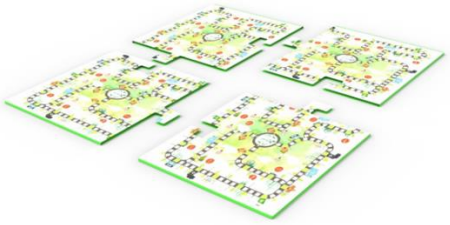
Which part do you like the most



Which part you don't like?



Final game design were followed by data gathers in previous parts like: focus group, interview, computer game evaluation. We implement children opinion and promote game's features.



Game instruments

Conclusion

As indicated earlier in the paper, the Fun Toolkit has been used in many studies by the mentioned authors but also in several studies by other authors. The Fun Toolkit, as presented here, is Fun, Fast and Fair. The tools in the Fun Toolkit gather only what is needed, are easy to answer, encourage truthful completion,

use few written words and are easily adapted. If it is used carefully, they can offer useful information for researchers and developers about children's preferences for different technologies. We designed an educational board game without the assistance of lecture content or other materials increased knowledge of student in EE area specifically recycling. However, the lecture increased knowledge outcomes more than the play of the educational game. Most important, an educational board game increased knowledge and self-efficacy outcomes without teachers or others present to manage game activity. Fun did not have a relationship with game related knowledge outcomes or a sustainable relationship with self-efficacy outcomes. However, the perceived fun aspect of a game may have influenced a learner to initiate game play, and sustain play long enough for the game's material and content to influence outcome changes.

Other conclusions include:

- The board game should be tested over an extended period of time, and with multiple educational doses and compared with different lecture styles/competencies. The average public school population should be included in a future trial. The game as an educational tool may be enhanced by the inclusion of other strategies, such as debriefing, skills activities, and more rigorous theory-based educational content.
- The simple board game format is useful and easily adapted not only for schools, but also for home, community, and other non-formal settings.
- The game should be fascinating by both boys and girls.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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