



Development and Study of the Effectiveness of Android-Based Serious Game of Emily and the Toy Box in Anger Management among Children: A Randomized Controlled Clinical Trial

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Original Article

Abstract

Introduction: Currently, anger and violence are one of the important reasons for referral of children and adolescents to counseling and psychotherapy centers. Anger management skills are among the most effective approaches to prevent the expansion of high-risk behaviors and to improve personal and social efficiency. The purpose of this study is to design a new game for anger prevention and teaching anger management skills in children.

Materials and Methods: Given the availability of smart phones, the game was designed and implemented as an Android-based application for children. Using the Basic4Android software, the game was developed according to the advice taken from peers expert in the psychology and computer fields. To evaluate the clinical effectiveness of the game, 105 children aged 8 to 12 years old from Khomeini Shahr, Iran, were selected and randomly divided into the control and experimental groups. The experimental group (n = 52) received the software while the control group (n = 53) were trained by the traditional method and group method under the supervision of a counselor. Anger rate was measured using the Novaco Anger Inventory (NAI). Paired t-test and independent t-test were administered for the intra- and intergroup comparisons, respectively.

Results: Participation in the traditional anger management training program and Emily and the Toy Box play in both groups significantly reduced the three components of anger and overall anger score on NAI. In other words, using Emily and the Toy Box game was just as effective as traditional methods of teaching anger management to children. However, the reduction in anger scores and its components in the experimental group averaged 10 to 17% more than the traditional methods.

Conclusion: The results of this study showed that the android application “Emily and the Toy Box” may be effective for teaching anger management skills in children aged 8 years and older and particularly, it reduces aggressive behaviors in children.

Keywords: Anger; Anger management; Serious game; Smart phone; Children

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Introduction

Today, teaching the skills needed to experience a better life is not adequately available to children. One of the most important of these skills is anger management. Children are greatly influenced by the behaviors of others, classmates, society, and parents, and by internalizing these unhealthy patterns, they build their personality based on them (1). These

children will soon grow up and develop their own personality patterns in society, which will lead to the development of a vicious cycle of aggression. Anger management skill is among the life skills discussed in psychology and in order for children to become familiar with this skill from childhood (2), its techniques are provided through attractive educational games. On the other hand, when children

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are played with, it helps their mental security. These games are very simple and free of charge and can be used in all environments on the one hand, and on the other hand, they have both educational and child's anger control aspects (3,4).

Today, children and adolescents spend most of their free time playing games. Games have penetrated the world of education to such an extent that they have led to the production of a group of purposeful games called serious games. These types of games are hidden learning tools among educational opportunities and can be used as a tool for education, entertainment, and information and communication technology (ICT) (5). The goal of the serious games is multiple learning, which is applied in many fields and covers all age groups. Learning through serious games has many educational values that ensure intrinsic motivation based on learning concepts based on constructive psychological theories, create cognitive contradictions, and provide temporary learning (5,6).

Nowadays, smartphones have become an attractive accessible tool for families and children among all sections of society. Given the evident effect of game-based education and the negative effects of anger on children's future (7), this study is carried out with the aim to design a smart mobile game and investigate its clinical effect on anger management education in children.

Materials and Methods

This study was a randomized controlled clinical trial that was conducted in 2018 in Khomeini Shahr, Isfahan Province, Iran. The present study was approved with the ethics code IR.SSRC.REC.1399.038. The samples were selected from children whose parents had given their consent to participate in the study by signing an informed consent form.

Participants: The target population included children aged 8 to 12 educating in schools in Khomeini Shahr in 2018; one of the schools in the city was selected by random sampling and lottery method. The study exclusion criteria were absenteeism for more than two sessions of the behavioral training sessions. All children of the school were called to study by informing their parents. Inviting parents of the second- to fifth-grade students, the study process was explained to them during a briefing session. Then, with the presence of a consultant and using simple random sampling method (lottery), participants were determined. Selection criteria were considered according to the opinion of the consultant. The sample size was estimated at 105 based on previous studies (8,9).

Game design: After referring to a psychiatrist who specialized in anger and its management and

collecting information and before modeling the software, to get an idea of the details of the software elements and ensure the completeness of the steps, the paper drawing method was used to initially design the "Emily and the Toy Box" software (Figure 1).

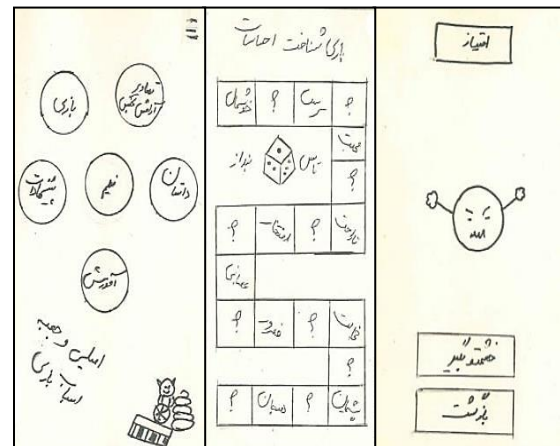


Figure 1. Software paper drawing of software

Given the unique features of Unified Modeling Language (UML) (StarUML 3, MKLabs Co., Ltd., Seoul, South Korea) in software modeling, this tool was employed to clarify the details of the "Emily and the Toy Box" game. From the set of UML diagrams, the user case diagram, activity diagram, and sequence diagrams were selected.

After modeling, the Agile methodology was selected as the software development process due to its agility; Because this methodology tries to design the program according to customer needs and the probability of failure in the project is less (10). Next, with a comprehensive review of the programming tools, the software was implemented using the Basic4Android programming language, which due to the low amount of codes, is a simple language in software designing and its output is in Java format. This software includes anger management techniques, soothing images, related movies and cartoons, audio and video stories, training, games, etc. to recognize and manage anger. Figure 2 depicts the software environment.

Evaluation tool: In order to evaluate the effectiveness of the software, it was necessary to collect and analyze data. One of the most important anger measurement questionnaires is the Novaco Anger Inventory (NAI). He considers anger to be a mental emotional state that is associated with physiological arousal and cognitive conflict and aggressive thoughts. Anger is a normal emotion with multiple adaptive aspects that, if its frequency, intensity, and duration exceed the adaptive aspects, it is a functional disorder (11).



Figure 2. Designed software environment: Software homepage (a), slider page (b), emotion recognition game (c), audio story (d), soothing images (e), watching movies and cartoons (f), learning section (g), and introduction of anger management techniques (h)

According to Novaco, when a person is aroused, several major behavioral responses take place, including “physical coping, passive aggression, and avoidant withdrawal”, which are measured by NAI. According to Novaco, external events, internal cognitive processes, behavioral reactions, and physiological reactions interact. This inventory is a valid and useful tool for assessing the anger of normal and disordered populations, which puts the person in certain external and internal situations and leads to arousal, and thus, assesses the level of anger and aggression of the individual. NAI consists of 3 components and 16 items to measure anger, aggression, and resentment (12). The dimensions of the inventory and its related items include aggressive behaviors, aggressive thinking, and aggressive feeling based on items 1 to 8, items 9 to 12, and items 13 to 16, respectively.

In order to score NAI, the values of 0, 1, 2, and 3 were assigned to each of the four options of never, rarely, sometimes, and always, respectively. The scores of the 16 items of the inventory were added together to gain the total score, with the minimum and maximum possible total scores being zero and 48, respectively. Finally, a score of 0-16, 17-24, and above 24 respectively indicated low aggression, moderate aggression, and high aggression. This inventory has been validated in Persian by Malekpour et al. (13). In the present study, the Persian version of the standard

NAI, which was designed for primary and secondary school children, was used and its reliability was determined using the Cronbach’s alpha coefficient. This inventory should be completed by parents or a person who knows the child well. The scale was provided to the parents during a meeting and was completed by them before and after the intervention.

Intervention: After collecting the pre-test information, the software was installed on the smart phones of the experimental group and the parents were instructed to work with it. The experimental group underwent the training intervention for 360 minutes in eight 45-minute sessions (Thursdays) with the “Emily and the Toy Box” software. This software was designed by the research team in consultation with computer and psychology professors and included the main factors in anger management that provided various suggestions and activities in this field to the user and his family in the form of “education, playing, stories, movies, and pictures”. Moreover, all aspects of traditional education and treatment used in clinics and counseling centers were designed in a simple and understandable form for children, and all the items that the children would encounter and need to learn were depicted. It should be noted that the control group was trained in the traditional method (using the teacher-centered method and group counseling in the form of questions and

answers) under the supervision of the counselor during six 60-minute sessions on Thursdays at their own school in two groups of 26 and 27.

The normal data distribution was examined using the Kolmogorov-Smirnov (K-S) test. Besides, the intra-group and inter-group comparisons were performed using Wilcoxon and Mann-Whitney tests, respectively. Finally, the data were analyzed in SPSS software (version 22, IBM Corporation, Armonk, NY, USA) and $P < 0.05$ was considered as the significant level. Power analysis was performed using G*Power software (G*Power 3.1.5 freeware, University of Düsseldorf, Düsseldorf, Germany) (14).

Results

After the briefing session, 58 and 61 subjects were selected for the control and experimental groups, respectively. Finally, 14 samples were excluded from the study due to the lack of consent of their families or lack of smartphones, and the study began with 53 people in the control group and 52 people in the experimental group. There was no drop during the study and hence, no intention-to-treat (ITT) analysis was performed.

Due to gender segregation in the primary education course in Iran, all children participating in the present study were boys. The K-S test results indicated that the data of the two groups did not follow the normal distribution. The demographic characteristics of the participants are presented in table 1.

Given the above table, the two groups did not differ significantly in terms of age and level of education; however, there was a significant difference between the education levels of the parents of the two groups; In the experimental group, 26.8% of fathers and 30.7% of mothers had university degrees and this rate was 5.7% and 9.5% in the control group, respectively.

The reliability of the test based on the Cronbach's alpha coefficient was 0.72. At baseline, there was no significant difference between the two groups in terms of anger and its components. The mean score of anger and its components before and after the intervention are presented in table 2.

Power analysis showed that the lack of a significant difference between the two groups was not due to the sample size. Participation in the traditional anger management training program and the use of the "Emily and the Toy Box" game in both groups significantly reduced the three components of anger and the overall anger score on NAI ($P \leq 0.001$ in all cases). Comparisons between the two groups revealed no significant difference in any of the studied indicators. In other words, the use of the "Emily and the Toy Box" software was as effective as the traditional methods in teaching children anger management; However, the reduction in anger scores and its components in the experimental group was on average 10 to 17% higher than that in the traditional methods (Table 2).

Table 1. Demographic characteristics of the study subjects

Variable	Levels of qualitative variables	Control group (n = 53)	Experimental group (n = 52)	Total (n = 105)	P value (Intergroup)	
Age (year) (mean ± SD)		9.23 ± 1.56	9.10 ± 1.43	9.16 ± 1.49	0.710	
Grade [n (%)]	First	0 (0)	3 (5.8)	3 (29.0)	0.970	
	Second	25 (47.2)	6 (11.5)	31 (29.5)		
	Third	3 (5.7)	17 (32.7)	20 (19.0)		
	Fourth	3 (5.7)	20 (38.5)	23 (21.9)		
	Fifth	20 (37.7)	4 (7.7)	24 (22.9)		
	Sixth	2 (3.8)	2 (3.8)	4 (3.8)		
Father's education level [n (%)]	Illiterate	3 (5.7)	4 (7.7)	7 (6.7)	0.007*	
	Elementary	11 (20.8)	5 (9.6)	16 (15.2)		
	Cycle	34 (18.0)	10 (19.2)	28 (26.7)		
	Diploma	34 (18.0)	19 (36.5)	37 (35.2)		
	Associate	1 (1.9)	2 (3.8)	3 (2.9)		
	BSc	2 (3.8)	10 (19.2)	12 (11.4)		
	MSc	0 (0)	2 (3.8)	2 (1.9)		
	Illiterate	2 (3.8)	2 (3.8)	2 (3.8)		0.018*
	Elementary	7 (13.2)	5 (9.6)	12 (11.4)		
	Cycle	14 (26.4)	8 (15.4)	22 (21.0)		
Diploma	25 (47.02)	21 (40.4)	46 (43.8)			
Mother's education level [n (%)]	Associate	2 (3.8)	1 (1.9)	3 (2.9)		
	BSc	3 (5.7)	13 (25.0)	16 (15.2)		
	MSc	0 (0)	2 (3.8)	2 (1.9)		

In the post-test phase, the number of answers to the items with 3 points decreased in both groups and the number of answers to the items with 0 and 1 points increased [due to the four-choice items, the number of choices for each option in the control group ranged from zero to 848 (53 people, 16 numbers for each option (and in the experimental group, it could be between zero and 832)]. However, in response to the items with 2 points, an increase and a decrease were observed in the control group and in the experimental group, respectively; this decrease difference was mainly from 3 points to 2 points in the control group and from 3 points to 1 points in the experimental group (Table 3).

Table 3. Answers of the control and experimental groups (pre-test and post-test)

Group	Level	Answering the questions of the control and experimental groups (Primary and final)				
		0	1	2	3	Total
Control	Pre-test	271	213	219	145	848
	Post-test	301	249	240	58	848
Experiment	Pre-test	216	259	229	128	832
	Post-test	281	333	201	17	832

Comparisons between the groups indicated that despite the lack of significant differences between the two groups in the overall scores of the inventory and its sub-categories, the response of the experimental group to items 9, 12, and 15 in the post-test stage was significantly different from that of the control group (Table 4).

Discussion

Taking into account the increase in anger and violence in children and adolescents and the dangers it may pose to society in the future, as well as the lack referring to the doctor and the high costs of treatment and counseling, a software was proposed in the

present study to teach anger management skills to children. The collected content along with the materials, games, and fun and attractive activities of this software to reduce anger, along with its management skill training were included in the program in different stages. Given the findings, it seems that the produced "Emily and the Toy Box" software was successful in this goal. It should be noted that the reduction rate of the scores of anger and its components in the post-test stage in the experimental group, despite the lack of significant differences between the two groups, was on average 10 to 17% higher than the control group, which is clinically remarkable. A reason for this difference may be the difference in the education level of the parents, which for both parents in the experimental group was significantly higher than the control group. It is also possible that this difference would be statistically significant if anger is assessed on a more accurate scale or the duration of working with the software is increased.

Paying attention to the problems of childhood and adolescence is important for both the individual and the community; as not treating these problems not only leads to significant problems in childhood, but can also cause mental disorders in adulthood (15). Significant mental disorders in childhood, even if transient, are likely to have serious consequences; because they may impair the child's learning and development (16). The extreme anger has significant physical and psychological consequences. Physically, anger increases heart rate and respiration and can lead to symptoms such as tremors, difficulty sleeping and resting, indigestion, and stomachache (1). Psychologically, anger disrupts normal mental and psychological functions and causes a loss of vitality (7). Extreme anger leads to quick and hasty decisions and creates difficult problems and may even lead to harassment of the angry person and others and even suicide (7).

Table 4. Answers to items 9, 12, and 15 in the two groups in the post-test stage

Question number	Text of question	Group	0 (Never)	1 (Rarely)	2 (Sometimes)	3 (Always)	P value (Intergroup)
9	When he loses the game, he gets angry and curses.	Experiment	21 (40.4)	23 (44.2)	8 (15.4)	0 (0)	0.034
		Control	16 (30.2)	17 (32.1)	18 (34.0)	2 (3.8)	
12	He does not accept friendly competition and considers the other side as his enemy in the game.	Experiment	35 (67.3)	15 (28.8)	2 (3.8)	0 (0)	0.027
		Control	27 (50.9)	14 (26.4)	10 (18.9)	2 (3.8)	
15	He is hasty and cannot bear to wait for his wishes to be fulfilled.	Experiment	6 (11.5)	15 (28.8)	20 (38.5)	11 (21.2)	0.022
		Control	8 (15.1)	8 (15.1)	16 (30.2)	21 (39.6)	

Data are reported as n (%).

Various investigations have been conducted on anger management. Given these studies, Parent Management Training (PMT), Cognitive Behavioral Therapy (CBT), Storytelling, and Play therapy are traditional ways of anger management (4,7,12). Modern ways of anger management include the use of computers and smart phones. So far, several Android-based softwares have been designed in the field of anger management, most of which, both in Persian and English, address anger management or control based on texts, which have only an educational aspect and are mostly related to adults.

Based on the reviews, to date, no Android-based game has been designed in Persian to control anger. However, so far in Iran, several traditional bead and screen therapy games have been scientifically designed and produced by psychologists to help and teach children and adolescents to gain life skills, which are available as physical games. Among these games, one can mention the anger control game collection (to manage anger emotion). The main attempt in this therapeutic game is to prevent behaviors arising from the anger emotion, which often manifests itself with nervous and impulsive behaviors. Furthermore, the collection of self-control therapy games (for emotion management) includes 6 therapy games is for children and adolescents aged 6 to 12 years, which teaches children self-control skills (17).

Anger and Irritability Management Skills (AIMS) software has been designed for retirees and military personnel. This software, which can be used both online and on IOS and Android platforms, is not considered a game and consists of four main parts: "learning, recording anger, tools, and anger management plan". Using this software, a person can record the history, causes, and intensity of their anger and control it with calming techniques. This application has been designed for adults and does not have a suitable appearance for children (18).

One of the anger control games is The Boy Who Could Not Control His Anger. This mobile game to help control anger is based on an inspiring childish video story about a boy who cannot control his anger. This inspiring story helps children control their anger and helps them understand and learn to maintain their mood when they discover powerful life-changing elements. The disadvantages of this game include the unavailability for Iranians and the lack of inclusion of the Persian language in it (18).

The Anger Management program in 2018 was recognized by users as the best software that included four sections "understanding your anger, chronic anger management, instant anger management, tips

and warnings". This program contains only images and text and lacks an entertaining environment for the clients; However, due to the images in it, it is more attractive to users compared to the software that has more text (18).

The "Emily and the Toy Box" game is a suitable game for Persian-speaking children aged 8 to 12, the effectiveness of which was confirmed in the present study. The advantage of this program compared to programs designed in Persian was that it is not based on text and is designed for children taking into account mental and visual appeals. It also provides the children with a variety of ways to manage anger. This program has advantages such as being compatible with Iranian culture and being more comprehensive in comparison to programs designed in English.

Limitations

The program designed in the present study is now in its initial version and can only be used in the Android environment. Besides, its effect cannot be generalized to children with clinical disorders of anger management (proven by validated psychological tests) or under medication to control aggressive behaviors.

Recommendations

This software can be used in future studies to determine its effectiveness in comparison with standard treatments for children with clinical syndromes and aggressive behaviors. Furthermore, software design for parents, caregivers, and educators and special design for age groups based on children's cognitive-psychological-perceptual development will be appropriate.

Conclusion

The "Emily and the Toy Box" Android software seems to have been successful in teaching anger management to children aged 8 to 12, reducing aggressive behaviors at this age.

Acknowledgments

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Authors' Contribution

Mozhdeh Sadat Mousavi: Study design and ideation, supportive, executive, and scientific study services, providing study equipment and samples, data collection, analysis and interpretation of results, specialized statistical services, manuscript preparation, specialized evaluation of the manuscript in terms of scientific concepts, approval of the final manuscript to be submitted to the journal office, the responsibility of maintaining the integrity of the study process from the beginning to the publication, and responding to the referees' comments; Atefeh Ahmadi-Olunabadi: Study design and ideation, supportive, analysis and interpretation of results, manuscript preparation, specialized evaluation of the manuscript in terms of scientific concepts, approval of the final manuscript to be submitted to the journal office, the responsibility of

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Conflict of Interest

The authors declare no conflict of interests. Mozhdeh Sadat Mousavi is a bachelor's degree graduate in software engineering from Sepahan Science and Technology Institute of Higher Education and Dr Atefeh Ahmadi-Olunabadi is the director of Tutia Counseling Center and a faculty member of Sepahan Science and Technology Institute of Higher Education.

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