Chapter 17
Educational Computer Games and Social Skills Training

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Abstract This chapter presents the application of educational computer games aiming to improve emotional understanding in children with ASD. A game, designed specifically for children with ASD and based on the ability model of emotional intelligence [22], is introduced. This model suggests that emotional intelligence is based on our four focus areas: perceived emotions, use of emotions to facilitate thought, understanding emotions and managing emotions. We selected this model because it draws a specific focus to understanding emotions through verbal and non-verbal interventions.

The game consists of seven modules:

1. Completion of a sentence with target pictures, denoting emotion;
2. Matching verbal exclamation with the corresponding picture denoting emotion;
3. Finding two identical emoticons;
4. Matching emoticons with situational picture-based emotions;
5. Matching pictured emotion with an emoticon;
6. Finding identical emotions in different pictures; and
7. Matching the sentence describing an emotion with a picture.

The game offers participants a specific combination of visual representation and auditory perception of nominated emotions. In addition, it offers the opportunity for the emotion to be depicted and accessible on target pictures—facial expressions and adapted situational images. The Chapter discusses the principles of game development and its seven components. Data collected from the pilot testing with two groups of children—typically developing and children with ASD—are systematized. Enhancement of social skills and emotional intelligence and its key components,

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namely, emotion perception and understanding, is a fundamental part of direct and indirect interventions that support the development of children with ASD. Such skills would widen the opportunities for the children to establish and build relationships with peers, be better accepted in society and reach an improved functional level.

Keywords ASD · Educational computer games · Social skills · Emotional intelligence

17.1 Introduction

17.1.1 Autism Spectrum Disorders

Autism spectrum disorders (ASD) include problems in social communication and repetitive behaviours with a genetic or other cause. In today's world, many people with ASD are able to develop the ability to function independently, but some are still unable to live on their own. Successful medical practices and behavioural interventions that positively influence children with ASD, especially those with comorbidity, remain the focus of practitioners and researchers [1]. Autism is a heterogeneous disorder. Current classifications introduce the term ASD using additional clinical descriptions to differentiate individuals [2]. The latest version of DSM-V places the focus on diagnosis and includes two domains. The first is related to social communication, and the second includes restricted, repetitive or unusual sensory-motor behaviours. A differentiation scale to assess the severity of the symptoms is also introduced. Problems in the development of social skills in individuals with ASD may include the following symptoms observed in multiple contexts: social reciprocity disorders, non-verbal communication disorders and disorders in developing, maintaining and understanding relationships [3].

People with ASD display different behaviours in the context of their disturbances in social development and emotional organization. Some children have no desire for social communication and avoid it; others are actively looking for interaction, but do not have the know-how, empathy and skills [4]. People with ASD have difficulties recognizing and understanding the emotions of others, expressing their own emotions, recognizing emotional expressions, and understanding them through the faces of others, as they are likely to see the individual elements of the face rather than the expression as a whole [5].

There is a delay in the development of facial expressions processing in children who show ASD features [6], including slow recognition of emotions [7], difficulties interpreting emotional cues and body language [8] different patterns of brain responses to emotional stimuli [9] and weak reliance on emotional information observing the face, probably resulting in difficulties in understanding social situations [10]. These changes are probably related to many environmental factors, incl. adverse childhood events that may impair the development of emotional information processing and lower the focus on understanding facial expression [11]. Difficulties

in recognizing facial expression of emotions depend on children's age, as children between 2 and 4 years of age are more likely to confuse emotion when relying on human faces [12].

ASD individuals have problems solving tasks for analysis of social situations and complex emotions in feature films. They may experience difficulties in some aspects of empathy processing, where language-based interventions are suggested as therapeutic strategies [13].

Computer technology can be used in working with individuals with ASD, especially in the development of verbal skills as well as to support the exchange of information between people, improve the overall quality of life [14], and develop social skills [15]. Computer training can hone emotion recognition and the development of social cognition [16]. Emotional recognition skills acquired through computer-based training can be successfully transferred into everyday life [17]. The application of computer games is perceived positively by children and their parents [18, 19]. Supporting the development of social skills and their application in life is a key factor for individuals with ASD, as it will enable them to have normal relationships with other people [20].

17.1.2 Emotional Intelligence (EI)

Emotions include feelings, thoughts and reactions of the nervous system, as well as physiological changes in the body and changes in behaviour. Emotions are of great importance for our functioning in the socium and response to certain events; therefore, emotions serve many functions [21].

Emotional intelligence (EI) has been defined by Salovey & Mayer as the "subset of social intelligence that involves the ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions" (p. 189) [22]. The authors also comment on "interpersonal intelligence", which includes the ability to observe the emotions of others and their moods and attempts to predict their behaviour.

EI includes verbal and nonverbal understanding and expression of emotions, regulation and use of emotional content for problem solving [23]. EI is the ability to understand, identify and manage emotions in such a way as to overcome anxiety, communicate efficiently, solve problems and manage conflicts. The Ability EI model emphasizes the relationship between cognition and emotion and the skills of perception, recognition and management of emotions [24]. EI includes the ability of a person to be involved in processing their own emotions, as well as the emotions of others, and to use this information as a guide for thinking and behaviour. People with high emotional intelligence can manage their emotions and possess adaptive skills [25].

The Ability EI model includes four branches that focus on the ability to perceive, use, understand and manage one's own emotions and the emotions of others. The first involves the ability to perceive one's own emotions and the emotions of

others, including the ability to identify emotions through language, appearance and behaviour. The second branch includes emotional facilitation of thinking—the individual's ability to incorporate emotions into prioritized areas of thinking by focusing on important things. The third branch is related to understanding and analyzing emotions, the ability to nominate emotions, to understand their meaning and to distinguish them when similar words and expressions are used to denote them, and to understand the states associated with a combination of emotions. The fourth branch represents the ability to manage emotions and the impact of this regulation on the emotional and intellectual growth [26].

Additionally, the modified version of the model includes an expansion of the section "Understanding Emotion," which initially includes the ability to identify emotions and know their causes and to understand complex emotions. An assessment of the ability of emotional forecasting has been added to that section [25].

Emotions contain and carry information (e.g., happiness leads to a desire to socialize with other people, anger leads to a desire to attack others, fear leads to a desire to run away). Each emotion contains a message and a probable action associated with it. Understanding emotional messages and the potential actions associated with them helps individuals to integrate into society and to create satisfying relationships [27].

Emotional recognition includes the ability to understand the expressions of others that represent their feelings, including the use of non-verbal channels (e.g., face, body, voice). This is directly related to the possibilities for interactions and appropriate behavior [28].

17.1.3 Computer Game for the Development of Social Skills in Children with ASD

The aim of the game is to improve children's social skills by teaching them to recognize emotions, to increase children's knowledge of emotions, and to expand their knowledge of situations related to these emotions. The facial and physical expressions of people who experience emotions are also a point of focus. We believe that this would increase the social capacity of children with autism and improve their daily interactions with other people [29], their ability to manage their own emotions and the emotions of others [30], their inner experiences and outer relationships [26], and promote successful communication and understanding of thought as well as their orientation towards certain goals [31].

The ability EI model suggests that emotional intelligence is a pivotal skill in one's life, and an important element of this model is the understanding of emotions, including their verbal representations [25].

Improving the understanding of emotions in children with autism and their emotional intelligence can be achieved through several means, such as the following:

- The use of plot pictures emphasizing the expression of emotion and its nomination;
- The use of different types of tasks with multiple choice options aimed at promoting the recognition of a set of emotions.
- The use of situational pictures containing both people and emoticons to differentiate emotions with the same name;
- The search for matches between emoticons and facial expressions in humans;
- The reiteration of the emotion with both the correct and incorrect answer to create a visual image related to the verbal naming.

Interventions suitable for teaching children with ASD have been used in preparing the games. In the games, multiple visual stimuli and the same target emotion are presented in several ways, and children are tasked with completing a sentence in context, recognizing the emotion in multiple pictures, combining identical emotions, searching for a match between an emoticon and a picture, and recognizing the image in a picture and matching it to its name. The emotion is presented in different ways, and there is an opportunity to improve visual recognition and match the visual representation of the emotion with its name.

Another approach is the random presentation of the tasks in each group. Each time the child starts the game, a different order of tasks is presented to prevent the child from learning the answers or getting bored. The random presentation of the individual tasks is expected to increase the motivation for multiple repetitions of the game and promote learning.

17.1.4 Educational Game—Framework

The aim of the game is to improve emotion recognition, especially in themed (social) situations, and allow children to develop social/soft skills and to focus on the emotions of the other participants in the situation.

Voice instruction is used in the games, and emotions are provided both in the instructions and the correct/wrong answer. Thematic pictures containing children, adults, and emoticons are displayed on the screen. The emotion is depicted in color and the rest of the picture in black and white, so the focus is placed on the target group in color, denoting the emotion. In this way, the skills of children with ASD are used to focus on details but at the same time to present the emotion in a social context/plot picture. By transferring this knowledge to real situations, where they hear the name of the emotion or observe the emotion visually, children can improve their performance skills.

The verbal description of the emotional state or the situation has to be matched to the thematic picture/emoticon by the child. When a correct answer is given, the speaker names the related emotion, and the child is reinforced verbally by "Well done! You did it!" When the answer is wrong, the speaker names the emotion and prompts the child with "Try again!" For a better learning experience, the emotion is named after the choice, and this naming is combined with the feedback for the

correct or wrong answer. The game is targeted at children who can understand the task instructions, which are read aloud.

The record of each player's achievements displays the number of correct and incorrect answers and the time taken to answer the questions as well as the number of attempts used to listen to the condition, which is an important factor in the application of the game to children with ASD. Numerous listening attempts indicate difficulties in understanding the instructions and/or difficulties in understanding the name of the emotion, which is a very important measure. Motivation is maintained through the relatively small number of answer options, which increases the chance of a correct answer, even with the random choice of answers. This also supports learning as it provides positive feedback and focuses children's attention on naming and expressing emotion.

The games are provided sequentially in order to gradually complicate the tasks. The first mini-game starts with a sentence that explains a social situation and gives three possible emotions as answer options. The second game is an emotional exclamation and a situation prompting the user to choose between four different pictures depicting an emotional situation. The third task involves recognizing the same emotions with emoticons, and the correct answer is provided after the user's selection. The fourth task contains instructions for combining a picture with an emoticon. In this task, there are four possible situations denoting the same emotion, presented in two columns of four. The last task includes a description of an emotion and a search for a match between four pictures.

Each game includes several tasks with the same degree of complexity. Some techniques for working with children with ASD were used to improve learning and understanding: **the instructions are clearly articulated at a slow rate and contain only words with unambiguous meanings; sentences are short and clear with adequate pauses in between; the reinforcement for answering correctly is immediate; and the name of the emotion is reiterated.**

17.2 Game Description

17.2.1 Tasks—Mini-Game 1

Mini-Game 1 consists of 11 tasks displayed in different/consecutive panels each consisting of three pictures.

Setting: The child hears a sentence describing a particular situation related to a feeling or emotion. He/she has a choice of three thematic pictures and has to choose the one that best describes the emotion to complete the sentence. When answering correctly, the child hears the word denoting the emotion and is given verbal reinforcement as well. The aim is for the child to relate the situation described in the sentence to the emotion in order to identify the correct emotion and hear it stated verbally.

The expected result in this game is to improve the recognition of the emotions and the feelings of the others in various situations and develop skills for understanding their behaviors.

Example:

Instruction:

Choose the picture that best denotes the emotion to complete the sentence.

1. When something nice happens to us …

   The answers to choose from are:

   - We feel ashamed;
   - We feel pain;
   - We feel happy.

   The correct answer is "We feel happy" (Figs. 17.1 and 17.2).

   The sentences to be completed in Game 1 and the corresponding answers are as follows:

2. When we achieve something, we feel... Options containing answers and pictures related to emotions: we feel love; we feel proud; we feel scared.
3. When we see something unpleasant, we feel... Options containing answers and pictures related to emotions: disgusted; surprised; angry;
4. When we misbehave, we feel... Options containing answers and pictures related to emotions: scared, ashamed; in pain;
5. When something scary happens to us, we feel... Options containing answers and pictures related to emotions: upset; entertained; frightened;
6. When we do something, we enjoy, we feel.... Options containing answers and pictures related to emotions: disgusted; entertained; frightened;
7. When someone breaks something that belongs to us, we feel... Options containing answers and pictures related to emotions: upset; entertained; love;
8. When we fail to achieve something, we feel... Options containing answers and pictures related to emotions: surprised; love; frustrated;
9. When we get injured, we feel... Options containing answers and pictures related to emotions: pain; frustrated; frightened;
10. When someone does something unexpected, we feel... Options containing answers and pictures related to emotions: ashamed; surprised; sad;
11. When we are unable to do the things that we want, we feel... Options containing answers and pictures related to emotions: entertained; frightened; sad.

17.2.2 Tasks—Mini-Game 2

Mini-Game 2 contains 11 tasks displayed in consecutive panels in a random order on the screen.

Fig. 17.1 Screenshots of "Game 1"

Setting: There are four pictures on the screen. The child hears a verbal expression related to a feeling or emotion. The aim here is for the child to choose the picture that best corresponds to the emotion in the sentence. When the given answer is wrong, the child hears the word denoting the emotion and a statement that it does not correspond to the verbal expression as per the instructions.

The expected result is an improved ability to relate verbal expressions that explain the emotions to the picture that corresponds to the emotion.

Example:

Instruction:

Choose the picture that best matches the exclamation.

1. Ugh, this is disgusting!

   The answers to choose from are:

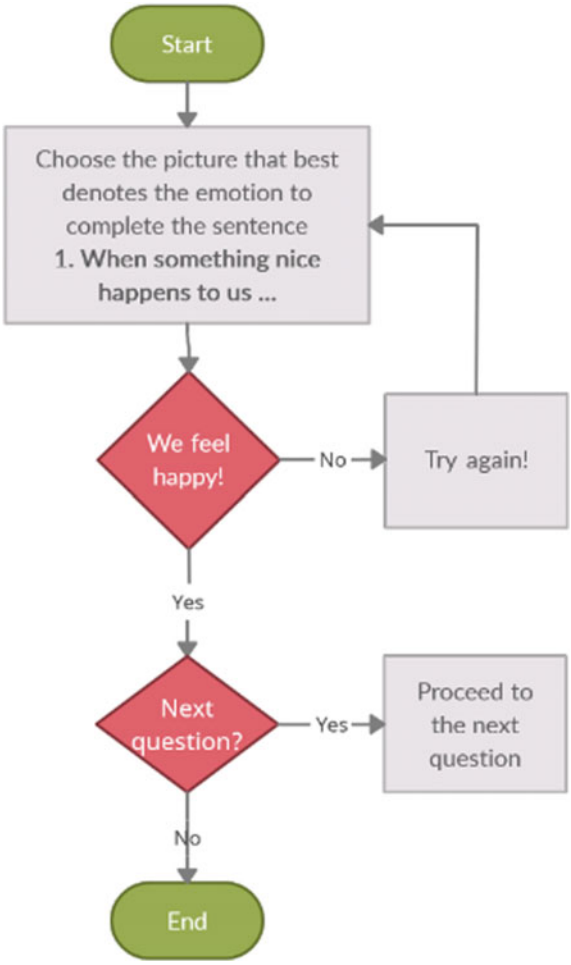

Fig. 17.2 Flowchart diagram of "Game 1"

- I am disgusted;
- I am angry;
- I am happy;
- I love you.

The correct answer is "I am disgusted" (Figs. 17.3 and 17.4).

The examples Mini-Game 2 include the following verbal exclamations:

2. Ugh! I am so angry! Possible answers and pictures related to emotions: I am scared; I am angry; I am surprised; I am in pain;

Fig. 17.3 Screenshot of "Game 2"

3. Ouch! It hurts! Possible answers and pictures related to emotions: I am in pain; I am angry; I am happy; I love you;
   I cannot do this; it is too difficult! possible answers and pictures related to emotions: i am ashamed; i am scared; i am in difficulty; i am afraid;
5. Aah, I am so scared! Possible answers and pictures related to emotions: I have fun; I am in pain; I am disgusted; I am scared;
6. Ooops, I am so sorry... Possible answers and pictures related to emotions: I have fun; I am in pain; I am ashamed; I am proud (of);
7. Wow, this is so much fun! Possible answers and pictures related to emotions; I am proud (of); I am in difficulty; I have fun;
8. Whoa, such a wonderful surprise! Possible answers and pictures related to emotions: I am surprised; I am scared; I love you; I have fun;
9. Yahoo! I am so proud; I did it! Possible answers and pictures related to emotions: I am in pain; I am in difficulty; I am proud (of); I am angry;

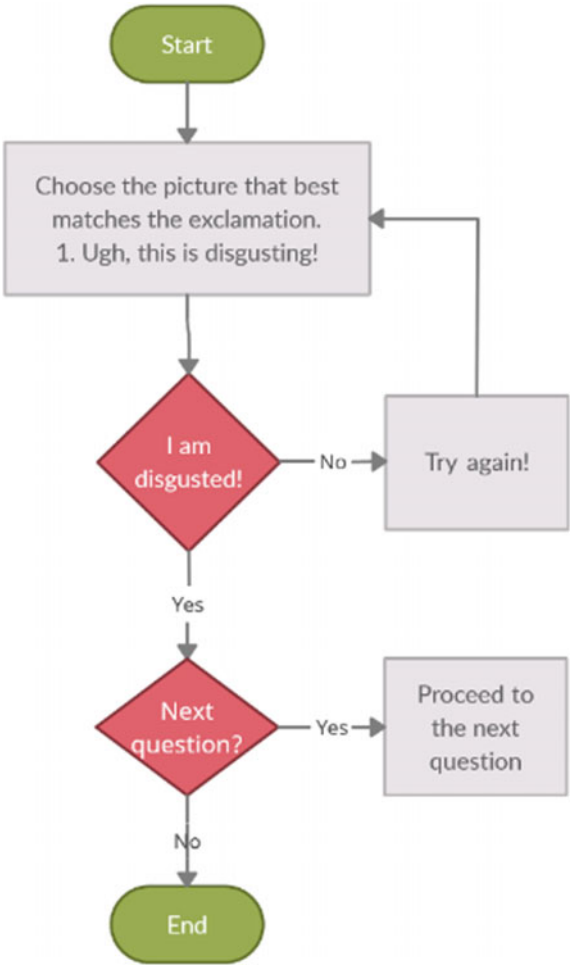

Fig. 17.4 Flowchart diagram of "Game 2"

10. Aah, you got me scared! Possible answers and pictures related to emotions: I am scared; I am sad; I love you; I am ashamed;
11. I love you! Possible answers and pictures related to emotions: I am happy; I am surprised; I love you; I have fun.

17.2.3 Tasks—Mini-Game 3

Mini-Game 3 contains five tasks displayed in a random order in consecutive panels on the screen.

Setting: There are eight emoticons on the screen, and the child is seeking to find the two identical ones among them. The task is to recognize the identical emotions

denoted by emoticons. Instructions are given verbally without naming the emotion. After the successful completion of the task, there is verbal feedback naming the emotion and verbal reinforcement.

Example:

Instruction:

Find the two emotions that are identical.
Correct answer: “It hurts.”
Reinforcement: “Well done, you did it!” (Figs. 17.5 and 17.6).

Fig. 17.5 Screenshot of “Game 3”

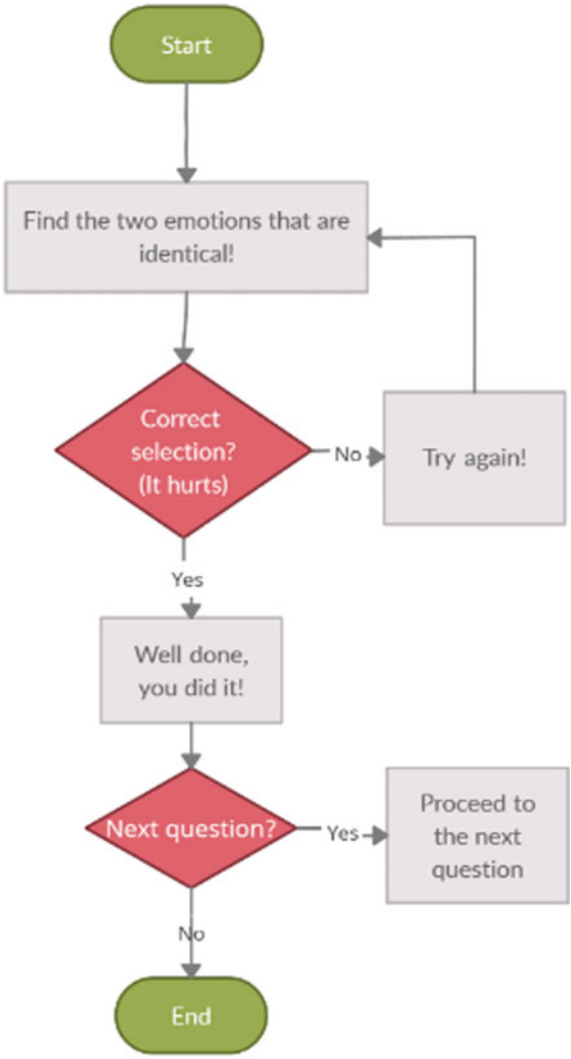

Fig. 17.6 Flowchart diagram of "Game 3"

17.2.4 Tasks—Mini-Game 4

Mini-Game 4 contains two tasks displayed in consecutive panels on the screen.

Setting: The child has to match a thematic picture denoting an emotion with the corresponding emoticon. After the successful completion of the task, there is verbal feedback naming the emotion and verbal reinforcement.

The aim of the task is to discover the emotion denoted in the thematic picture and recognize the same emotion denoted by the emoticon. When the answer given is wrong, there is an opportunity to teach the child the right emotion.

Fig. 17.7 Screenshots of "Game 4"

Example:

Instruction:

Match x picture with an emoticon (Figs. 17.7 and 17.8).

17.2.5 Tasks—Mini-Game 5

Mini-Game 5 consists of six tasks displayed in a random order in consecutive panels on the screen.

Settings and aim: To introduce a thematic picture denoting an emotion and match it to the relevant emoticon in an array of four emoticons. This task develops the skill of emotion recognition, represented both by a thematic picture and an emoticon.

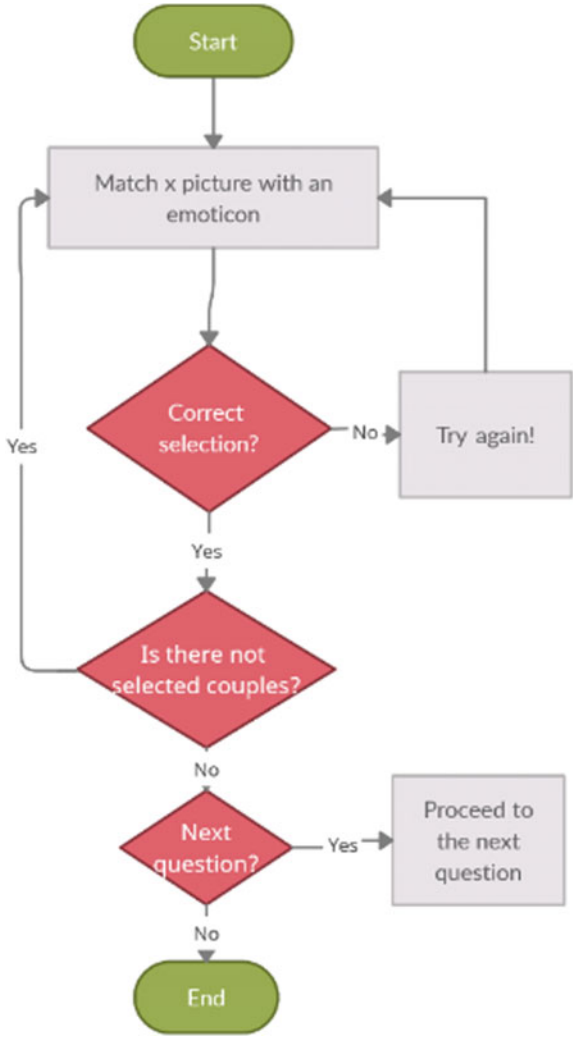

Fig. 17.8 Flowchart diagram of "Game 4"

After the successful completion of the task, there is verbal feedback naming the emotion and verbal reinforcement. If the child fails to match the items, the emotion is repeated, and the child hears "Try again!".

Example:

Instruction:

Which emoticon best matches the emotion shown in the picture?

The answers to choose from are:

- I am in difficulty;
- I am happy;

Fig. 17.9 Screenshots of "Game 5"

- I am surprised;
- I am in pain.

The correct answer is "I am in pain" (Figs. 17.9 and 17.10).

17.2.6 Tasks—Mini-Game 6

Mini-Game 6 consists of three tasks displayed in a random order in consecutive panels on the screen.

Setting and aim: To recognize identical emotions shown in different thematic pictures. Four coupled emotions and eight thematic pictures are shown on the same

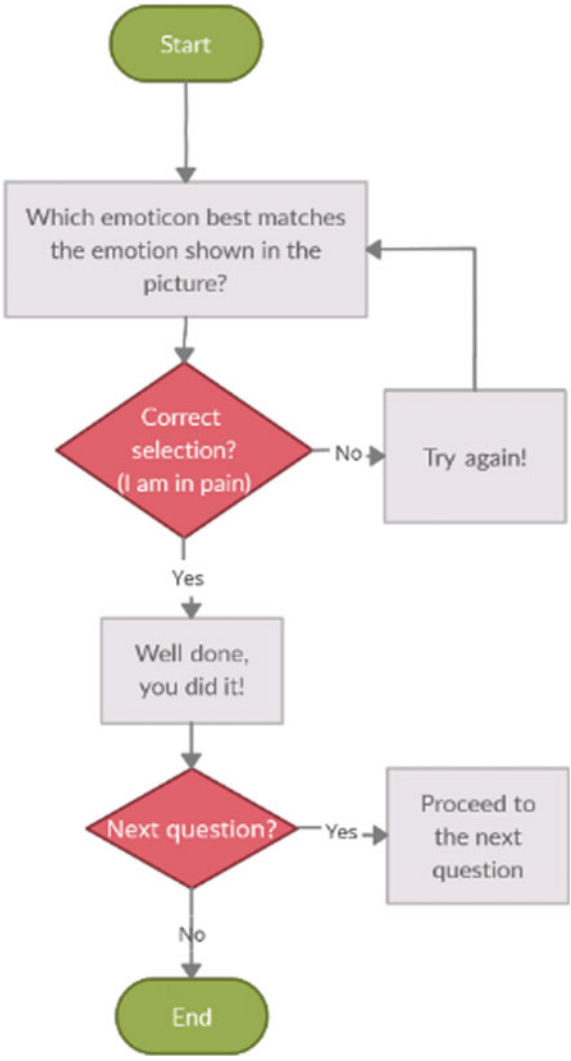

Fig. 17.10 Flowchart diagram of "Game 5"

screen. The task is successfully completed when two identical emotions are recognized and selected. The emotion is stated verbally, and the participant is verbally reinforced.

Example:

Instruction:

Match the pictures denoting identical emotions (Figs. 17.11 and 17.12)!

Fig. 17.11 Screenshots of "Game 6"

17.2.7 Tasks—Mini-Game 7

Mini-Game 7 consists of 26 tasks displayed in a random order in consecutive panels on the screen.

Setting and aim: To identify the corresponding emotion by asking a related question. All questions start with "In which picture..." The participant has to choose an answer in the array of four thematic pictures related to different emotions. Every emotion is named twice and has two corresponding thematic pictures.

Example:

Instructions:

1. In which picture is the child surprised?
   The answers to choose from are:

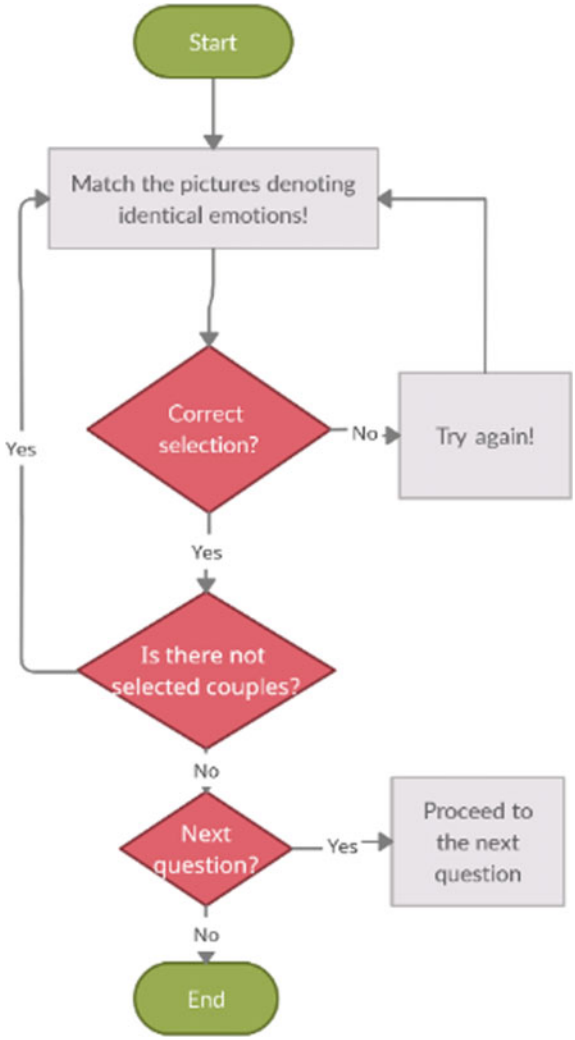

Fig. 17.12 Flowchart diagram of "Game 6"

- disgusted;
- scared;
- surprised;
- ashamed.

The correct answer is "I am surprised" (Figs. 17.13 and 17.14).

Here are some sample questions of Mini-Game 7:

2. In which picture is the child surprised? Possible answers: I am angry; I am in difficulty; I am surprised; I love you.
3. In which picture is the child sad? Possible answers: I am happy; I am sad; I am scared; I am in difficulty;

Fig. 17.13 Screenshot of Game 7

4. In which picture is the child happy? Possible answers: I am ashamed; I am proud (of); I am surprised; I am happy;
5. In which picture is the child angry? Possible answers: I am scared; I am in difficulty; I am angry; I am having fun;
6. In which picture is the child scared? Possible answers: I am angry; I am in pain; I am happy; I am scared;
7. In which picture is the child disgusted? Possible answers: I am scared; I am angry; I am sad; I am disgusted;
8. In which picture does the child feel proud? Possible answers: I love you; I am ashamed; I am proud (of); I am surprised;
9. In which picture is the child in difficulty? Possible answers: I am angry; I am in difficulty; I am disgusted; I am ashamed;

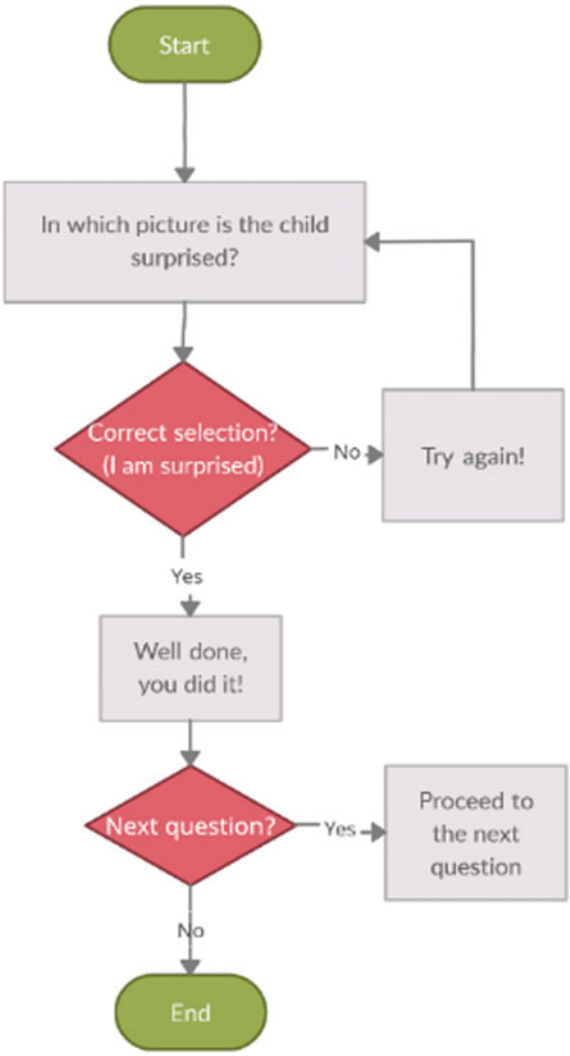

Fig. 17.14 Flowchart diagram of Game 7

10. In which picture is the child ashamed? Possible answers: I am in pain; I am ashamed; I am proud (of); I am sad;
11. In which picture is the child having fun? Possible answers: I am scared; I love you; I am having fun; I am surprised;
12. In which picture is the child loving somebody? Possible answers: I am scared; I am ashamed; I am happy; I love you.

17.3 Game Development

For the efficient implementation of the online game application, we used a specialized web-based platform called Moodle, which provides the opportunity to implement specific interactive activities suitable for use on desktops as well as on mobile devices (cell phones and/or tablets).

Moodle is a learning platform used to augment and move existing learning environments online. It is a virtual learning environment and can be used in education, training, and development, as well as in business settings. The software platform enables the development and design of new courses or programs from scratch by stacking modular media, text, and interactive blocks. The access to the platform is secured by an initially generated username and password so that we can control access, monitor the progress of the participant, and last but not least, collect statistical data for further analysis as well as for ongoing feedback and the regular coordination of the exercises.

The games were developed using Adobe Captivate (adobe.com) and exported in SCORM1.2 (Shareable Content Object Reference Model; https://scorm.com/?utm_source=google&utm_medium=natural_search). Learning objects have been integrated into the Learning Management System (LMS) Moodle. The games are based on scalable HTML5 and can be played on various devices, from a desktop computer to a tablet or smartphone. The child can access the game through the Moodle e-learning system. The introduction of games through SCORM packages allows re-use in e-learning systems that support the SCORM standard [32, 33]. This makes it possible to collect data related to the player's interaction with the individual elements of the game, such as the answers given, the length of the game, and the time between the individual interactions with the elements of the game. The games can also be used without an e-learning system, but in such cases, the child's interactions with the objects in the game cannot be traced. Each interaction is accompanied by a voice instruction for task completion, supporting or encouraging the child to choose the right answer. Each time a question is introduced, a different set of possible answers is generated. In practice, the child can progress only when he/she selects the correct picture (Fig. 17.15).

The game algorithm follows the pattern below:

Fig. 17.15 Screenshots of "Game 1"

- start of the game: user clicks the start button, which says “Start”;
- user clicks on a button, which includes the name of the object “speaker,” to repeat the instructions for a task;
- user selects an image that is a wrong answer, which includes the name of the object “wrong”;
- user moves to the next question, which includes the name of the object “next”;
- user selects an image that is the correct answer, which includes the name of the object “correct”.

An interaction marked as correct is weighted two points, and all other interactions are weighted one point (note: Adobe Captivate requires at least one point to be awarded for the interaction to be included in the report). The child progresses through the game only if he/she answers the questions correctly. This means that when the game is over, fewer interactions show a better result.

For every interaction, the SCORM package reports the time of interaction based on the server to LMS in real time. This allows us to track the speed of the participant for the current interaction.

Moodle provides the option to obtain several types of reports for all users registered in the course: basic, graph, interactions report, objectives report (Figs. 17.16 and 17.17).

The data from the SCORM package in Moodle can be exported in a.xlsx format and further analyzed (Fig. 17.18).

For example, the data in the table (Fig. 17.18) represents the number of users and some additional information. One user played the game five times, another user

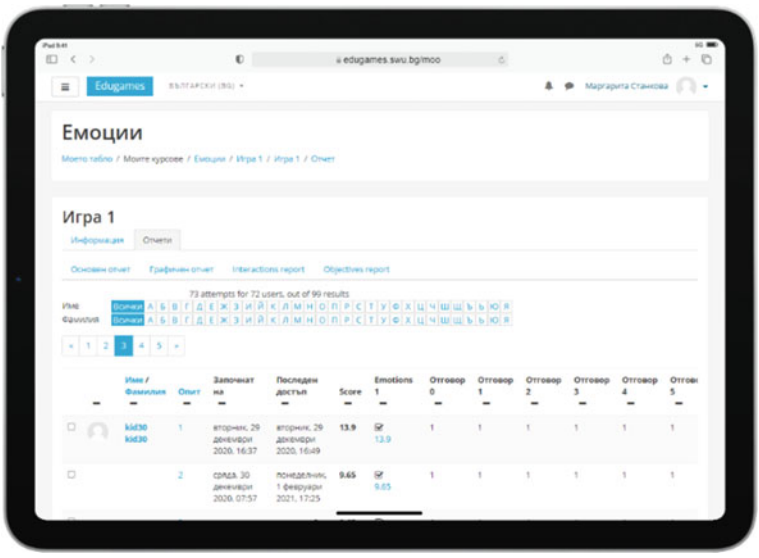

Fig. 17.16 Basic report for all participants

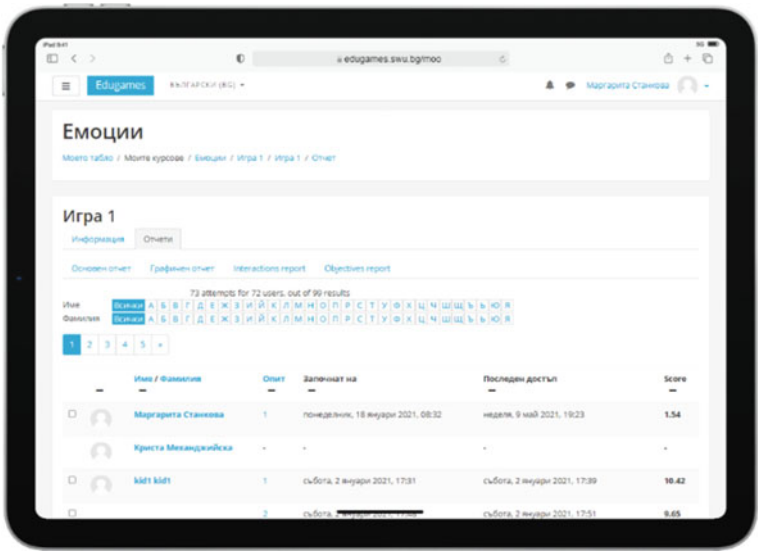

Fig. 17.17 Interaction report in Moodle

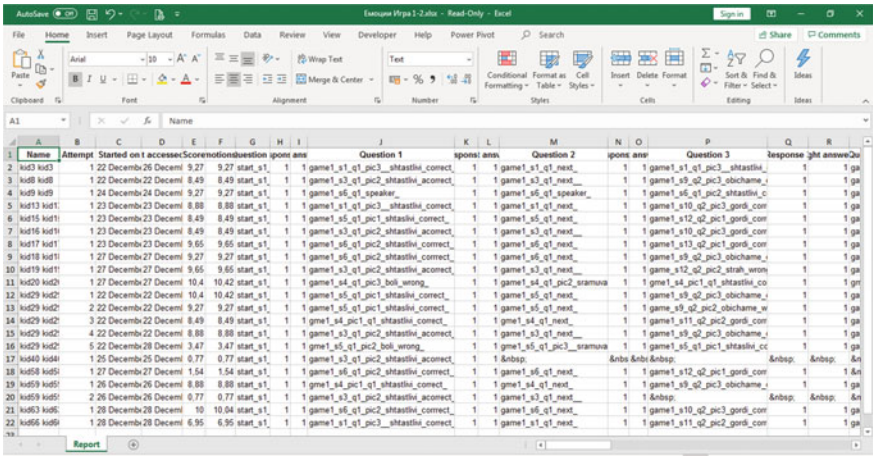

Fig. 17.18 Report exported in MS Excel (The screen was taken in the process of testing the game played by children)

played the game twice, and the rest played just once. The user "kid9" listened to the instructions for the first question twice and then clicked on the picture with the correct answer. The user "kid20" selected the wrong answer twice and in their third attempt, selected the correct one (columns J, M, and P show the answer chosen by the user. The correct picture contains the word "correct," and the wrong picture contains the word "wrong").

LMS Moodle also provides individual reports on each child's interaction with the objects in the game, which include general information about the learning object used (Fig. 17.19), detailed tracking of interactions (tracking details; Fig. 17.20), and

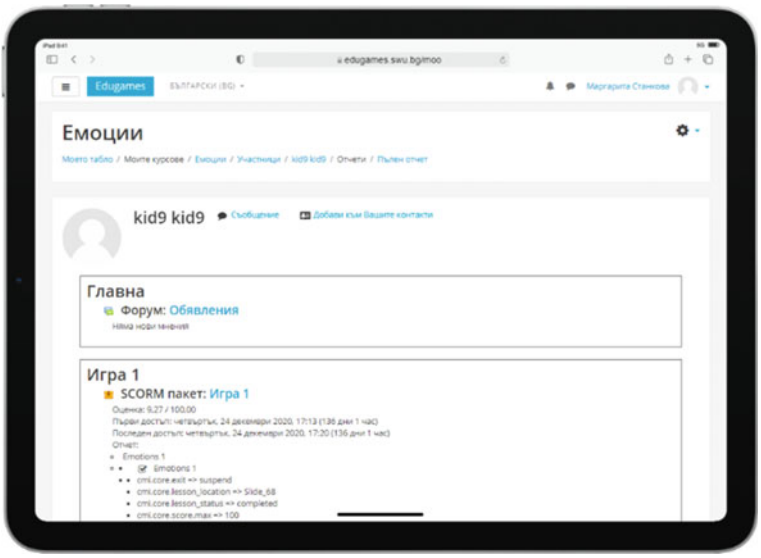

Fig. 17.19 Learning object report for user "kid9"

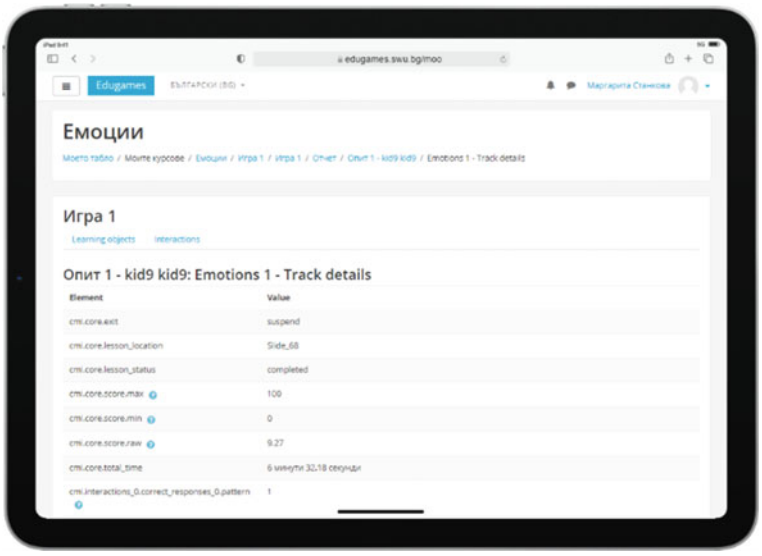

Fig. 17.20 Tracking details for user "kid9"

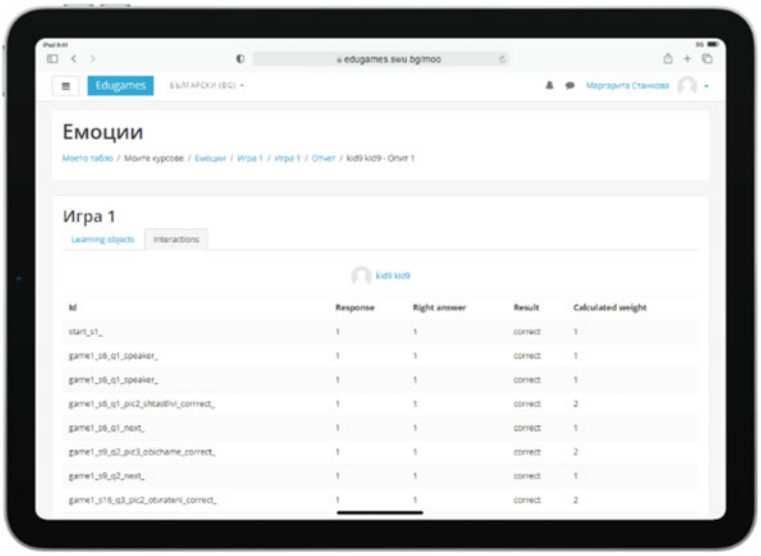

Fig. 17.21 Screenshot of interaction report for user "kid9"

information about interactions with each element included in the report of the game (Fig. 17.21). In the individual reports, the status of the learning object can be seen as well as total time, score, and link to the tracking details.

17.3.1 Pilot Testing on Two Groups of Children and Qualitative Data

The JASP statistical package (https://jasp-stats.org/) was used for statistical analysis, and a significance level of 0.05 was applied. The pilot measurement compared the results of the first and second games in control Group 1 (typically developing children) and Group 2 (children with ASD).

Mini-Game 1 was played by 13 children from Group 1 and 10 children from Group 2. Three of the children gave up at the beginning of the game and were not included in the analysis. Mini-Game 2 was played by 12 children from Group 1 and 9 children from Group 2. The majority of children in both groups played either Mini-Game 1 or Mini-Game 2. For the children who played Mini-Game 2, in Group 1, one child made two attempts, and in Group 2, four children made more than two attempts.

The descriptive statistics of the results for groups 1 and 2 for both mini-games are presented in Table 17.1.

Due to the small number of participants, we used non-parametric statistical methods for the comparison of independent samples (Mann–Whitney U test and

Table 17.1 Descriptive statistics of the wrong answers

	Group	N	Mean	SD	SE	Median	Mode
Number of wrong answers in Game 1	1	13	2.23	1.83	0.51	2	2
	2	7	5.29	5.25	1.98	4	2
Number of wrong answers in Game 2	1	13	3.00	2.77	0.77	2.5	0
	2	21	4.43	5.27	1.15	2	2

effect size estimation). The alternative hypothesis specified that the median of wrong answers in Group 1 was different from the median of wrong answers in Group 2. The effect size is given by the rank biserial correlation calculated in JASP. The data (Table 17.2) shows that we cannot reject the null hypothesis ($p > 0.05$).

Since Mini-Game 1 and Mini-Game 2 in both the control group and the ASD group were played by different children, we used the non-parametric Mann–Whitney U Test for independent samples with alternative hypotheses. Again, the median of wrong answers in Mini-Game 1 was different from the median of wrong answers in Mini-Game 2.

The data (Tables 17.3 and 17.4) shows that we cannot reject the null hypothesis for the equality of medians in both groups (control and ASD). We assume that the number of wrong answers during the playing of Mini-Game 1 is similar to the number of wrong answers during the playing of Mini-Game 2 in both groups.

Although the second game was more complicated than the first game, there was no statistically significant difference in both groups in terms of errors in the first and second game. There were no statistically significant differences between the number of errors in the control and ASD groups.

If the children from the ASD group, who played more than one game, are considered as separate cases, their progress can be highlighted. For example, kid30, who made 16 mistakes in Mini-Game 1 and listened to the questions eight times, had an average of 3.43 mistakes and four listening attempts in Mini-Game 2 and an average

Table 17.2 Independent samples Mann–Whitney U test

	W	p	Rank-Biserial Correlation
Wrong answers for Mini-Game 1	28.50	0.18	– 0.37
Wrong answers for Mini-Game 2	123.50	0.65	– 0.09

Note For the Mann–Whitney test, effect size is given by the rank biserial correlation

Table 17.3 Independent Samples Mann–Whitney U test Group 1

	W	p	Rank-Biserial Correlation
Wrong answers for Game 1	73.50	0.58	– 0.13

Note For the Mann–Whitney test, effect size is given by the rank biserial correlation

Table 17.4 Independent Samples Mann–Whitney U test Group 2

	W	p	Rank-Biserial Correlation
Wrong answers for Game 2	86.50	0.50	0.18

Note For the Mann–Whitney test, effect size is given by the rank biserial correlation

of one mistake in Mini-Game 5. We can probably assume that despite the gradual complication of the games, the child has an increasing number of correct answers and no additional listening attempts to the tasks in the games. Kid33 had an average of 11 errors and nine additional listening attempts in Mini-Game 2 and nine errors and two additional listening attempts in Mini-Game 5.

The qualitative analysis of parental feedback was done for the children in groups 1 and 2 who played at least one of the seven mini-games. Group 1 contained 26 participants aged between five and eight years who were predominantly girls (20 girls and 6 boys), and Group 2 contained 14 participants aged between five and eight years who were predominantly boys.

The questions were asked of the parents by phone. They were developed based on similar surveys [34] and were aimed at the usability of the games, the child's participation and interest in the game, entertainment, and the need for educational games. The first group of questions was focused on the parents' impression of the children's behavior during the game and the second part, on their personal impression of the game.

The parents' feedback can be summarized as follows:

Group I (Table 17.5).

Table 17.5 Group 1 parents' feedback

Feedback shared by the parents	No. of parents	%*
Child's participation		
The child enjoys the game and asks for more such examples	8	31
The child finds the game interesting	5	19
The child likes the game	7	27
The child is not interested at all	3	12
Personal opinion		
I do not find it useful	3	12
I find it instructive	2	8
I find it attractive and useful	12	46
I need more games like this	5	19

* *The percentages do not add up to a hundred, as some parents did not share a clear position or gave more than one answer*

Table 17.6 Group 2 parents' feedback

Feedback shared by the parents	No. of parents	%*
Child's participation		
The child plays the game as required but makes many mistakes	3	21
The child is not able to finish the game	6	43
The child likes the game	2	14
The child is not interested at all	3	21
Personal opinion		
I do not find it useful	1	7
I find it instructive	6	43
I find it attractive and useful	8	57
I need more games like this	6	43

* *The percentages do not add up to a hundred, as some parents did not share a clear position or gave more than one answer*

Group II (Table 17.6).

The parents in Group 2 frequently raised concerns about the flexibility in defining "emotion" and the meaning of "emoticon." Many participants commented that the instructions must be simple, and children had difficulty understanding the tasks.

17.4 Conclusions

The development of social skills and emotional intelligence can be enhanced and improved in both typically developing children and children with ASD through the application of educational computer games. A factor of basic importance in communication and the establishment of social relations is the understanding of emotions as a third component of the ability EI model. Understanding emotions through pictures is closely related to children's inclusion in social situations. This enables children to focus on the feelings of others and the situations that relate to them.

Through the use of educational computer games, the child is given the opportunity to explore a variety of visual social situations and compare various emotions in different settings to hear emotions described and seek to find their corresponding adapted images that carry related information.

The fact that children with ASD do not know the meanings of words and have difficulty naming emotions but at the same time maintain their attention on the game, means that the game can have a positive effect on the recognition and learning emotions. These exercises can help children with ASD to develop better social skills.

The skill of understanding others' emotions can be developed through multiple repetitions, providing right/wrong options, and combining visual and audio perception. There are certain implied rules that have to be observed when working with

children with ASD, namely focusing on a specific educational target, combining voice instruction with audio representation, using clear and unambiguous words, short phrases, and time lapses between instructions, combining target situational pictures as well as pictures of people and adapted ones. All these rules have been carefully taken into consideration and observed in the development of the games. Thus, we believe that this type of educational game can be used successfully in improving the understanding of emotions in children with difficulties to develop their social functioning.

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