# A Gaming Platform for Improving Emotional Intelligence of Children under Supervision of Parents

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***Abstract***

Nowadays, smart devices are growing extraordinarily. Children and teenagers are the major customers of such technologies and applications. They spent too much time in using smart devices for gaming. Hereby, we introduce *Remote kid* platform which enables parents to evaluate their children effectively using educational games. In this platform, the parent chooses a game for her/his children from the parent side mobile application and the server sends a message to child's application to start a game. At the end, the results of the game play will be reported to the parent application as the evaluation results. As a case, Emotional Intelligence (EI) has been considered in this paper which has deep effects on human success. Therefore, a test game has been developed based on the proposed platform to improve children's EI parameters based on Bar-On model and report the evaluated EI from the game play. *Remote kid* has been tested on a group of 4-6 years old children in a period of time. The research findings show that the designed game effectively improves some of the children's EI parameters.

***Key words****: Game-based learning, Platform, Emotional intelligence, Cloud message services*

# 1. Introduction

Recent years have witnessed a tremendous growth of mobile users and multimedia services, which are causing numerous applications to be released for mobile platforms such as android and iOS. Meanwhile, online games are popular multimedia applications that are facilitated by growth of communication infrastructures like Wi-Fi and technologies like D2D communications.

Digital Game-based learning is a research field that has received increased attention in recent years. While traditional digital learning games were used to teach scientific facts, the games can also be used to teach skills, judgment, behaviors, reasoning, procedures, creativity, language, etc. using various approaches [1]. Based on such growth, we motivated to develop a new platform for parents to encourage children to use their mobile devices more efficiently. The proposed platform, namely *Remote kid*, defines a game-based learning method and has been used to improve the Emotional intelligence (EI) of children under parents' control.

As the childhood is one of the most important periods of human life where the child learns her/his basic skills, children have been considered as the audiences of our gaming platform. We focus on improving Emotional intelligence (EI) of children via playing the games. Emotional intelligence first noticed in 1995, regarding a finding that showed people with average IQs outperform those with the highest IQs 70% of the time [2]. EI affects how we manage behavior, navigate social complexities, and make personal decisions that achieve positive results. If someone has higher emotional intelligence, she/he is able to recognize

her/his own emotional state and the emotional states of others, and engage with people in a way that draws them to her/him. We can use this understanding of emotions to relate better to other people, form healthier relationships, achieve greater success at work, and lead a more fulfilling life. Regardless of IQ which is constant in our lifecycle, EI is a flexible set of skills that can be acquired and improved with practice. Therefore, EI has been considered as a noticeable field of research from past two decades.

*Remote kid* is a platform employing game-based learning methods to improve children's EI. Each game that aims to improve specific EI parameters of the player, like happiness, self-stem, problem solving etc. (detail of EI parameters is explained in section. 3) could be developed under this platform. *Remote kid* enforces two different applications, one designed for children and one for parents. Parents' app allows them the ability to choose a game (based on children mood) and to encourage the child by a notification, to play the game. On the other hand, children's application is responsible to run the game chosen by parents, analyze the activity of the child to estimate her/his EI level in term of some EI parameters, and report them to parent's app. For example, if a child gets good result in a difficult and stressful situation of a game, it is a sign of her/his good level in stress management.

The remainder of the paper is organized as follows. An overview on related work is conducted in section 2, In section 3, an overview of emotional intelligence is introduced and then we explain the proposed platform in section 4. More details of game development will be explained in section5 by reviewing a case study. Section 6 presents the result of our evaluation and finally in section7, we conclude our study and talk about future works.

# 2. Related work

Tobias et al. have presented a complete review on game-based learning [3]. Some of the included studies such as [4] focus on improving the classification skills that is earned by multimedia games. Recently, some applications such as Kahoot [5] have been developed for evaluating the effectiveness of using games in educational areas. The results show that this kind of learning extremely increases the children's motivation. In addition, the authors in [6] develop digital puzzle games to improve children's spatial visualization and mental rotation. Their results prove the effectiveness of improving children skills by digital games. Problem solving is one of the important skills in EI as considered in Yang research [7]. Yang has focused on improving the ability of problem solving in children by developing a digital game and testing it on 44 students. Similar to [7], authors of [8] also emphasize on improving problem-solving ability in 5 years old children. Karime et.al. [9] also represent an interactive multimedia game for children which is based on RFID. Their game is under teacher control to teach children about new objects/entities.

On the other hand, there are some researches on developing AI-based games like [10] which develop a game to improve students' computational thinking. The authors of [11] focus on using collaborative diffusion to make games more intelligent for children. Analyzing the impact of these kind of games on players shows the positive impact when the games are attractive enough for children [12].

Regarding above discussion, none of the previous studies consider both aspects of a game, i.e. being used for learning whereas analyzing player's behavior too.

Reference [13] describes the positive impact of involving parents for improving children's skills while previous methods mostly were based on monitoring of children [14]. In this paper, we propose a platform for developing games where parents not only encourage their

children to play a game and monitor the activity of children in games, but also they are informed about the improvement of their children in EI parameters.

# 3. Emotional Intelligence

Emotional Intelligence is the capacity for recognizing our own feelings and those of others, for motivating ourselves and for managing emotions effectively. One of the first and still most widely-used models is the Emotional Quotient Inventory, EQ-I, introduced by Reuven Bar-On. His model divides Emotional Intelligence into five components, each assessed by a different sub-scale. Bar-On calls these *intrapersonal intelligence* (which contains self-awareness, self-esteem and assertiveness); *interpersonal intelligence* (empathy, social responsibility and social awareness); *adaptability* (problem-solving, reality testing and flexibility); *stress management* (stress tolerance and impulse control); and *general mood* (happiness and optimism) [15]. We consider Bar-On's model for evaluating EI parameters in this paper.

EI has a deep effect on wide aspects of our life from education to job, from family to friendship and so on. Many researches approve this reality such as TalentSmart which assesses emotional intelligence alongside 33 other important workplace skills, and indicates that emotional intelligence is the strongest predictor of performance, explaining a full 58% of success in all types of jobs [2]. In addition, childhood experiences form the fundamental of human lives and its effects on adulthood are noticeable .So the parents must be care about improving their children's skills via improving EI. [16]

As the game is a good media for practicing EI parameters, in next section we focus on proposed platform which gives the parents the ability to schedule the game play of their children and evaluate their EI parameters for further efforts.

# 4. Proposed approach

*Remote kid* is a Game-based learning platform to improve children's EI parameters under parent's supervision. The initial idea for *Remote kid* is to give parents the power of knowing how their children really do with EI-based games on their devices. In fact, chosen game could be closely related to child mood, for example if the child is upset, parent can choose a game which affects the happiness of the child and if she/he is angry, parent can choose a game to calm her/him. In parent's application, installed games are listed with details of EI parameters that are affected via playing them.

## 4.1 *Remote kid* architecture

*Remote kid* platform contains two different applications, one for children and the other for parents. Children application consist of some installed[1] games and also an EI evaluator module that is executed in background. Parent's application lets parent to see list of the games installed in child's application and allows her/him to choose desired one for running on children device. These applications are connected to each other via IP network. Both are based on android OS and are connected to each other (for sending notification) using cloud service of Parse[2], which is a free messaging service based on GCM (Google cloud messages). Fig.1. illustrates the relationship between above entities.

[1] which cannot be executed from the app, directly.
[2] Parse.com

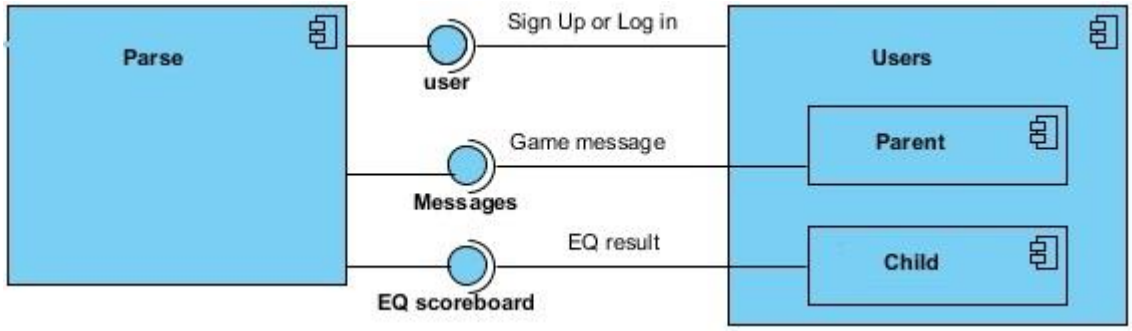



Fig 1. Architecture of *Remote kid*

*Remote kid* works as follows:

1- Parent has to register the parent's application and also the children's application in our cloud based platform.

2- Parent sees list of the games installed on client side application, each one aimed at certain EI parameters. Then she/he decides to choose suitable game by clicking on "Send" button. By that, a notification is sent to the children application (game's notification aims to catch child attention). Note that it is possible to send a game notification to more than a child at the same time.

3- Received notification on children application makes game running; then if child keeps playing, the application analyzes her/his behavior in background.

4- When the game finished, children's application sends EI scores to the parent application via notification.

In fact, not only the game must improve the EI capabilities of a child, but also it has to evaluate the child behaviors and score her/him in term of those factors. More details of scoring are explained in section 5.

### 4.3 Architecture

As explained before, Parent application's activities mainly include, registering children, sending game request to children application, and checking children's game result. Children application user interface only has login activity for child and also the games activities which are executed independently.

One of the key points of our design is proposing a programming interface for developing games. In fact, the proposed classes for interacting with the platform and also evaluating EI factors can be used simply by game developers. In order to show the dynamic of the system, the interaction diagram of *Remote kid* is shown in Fig.2.

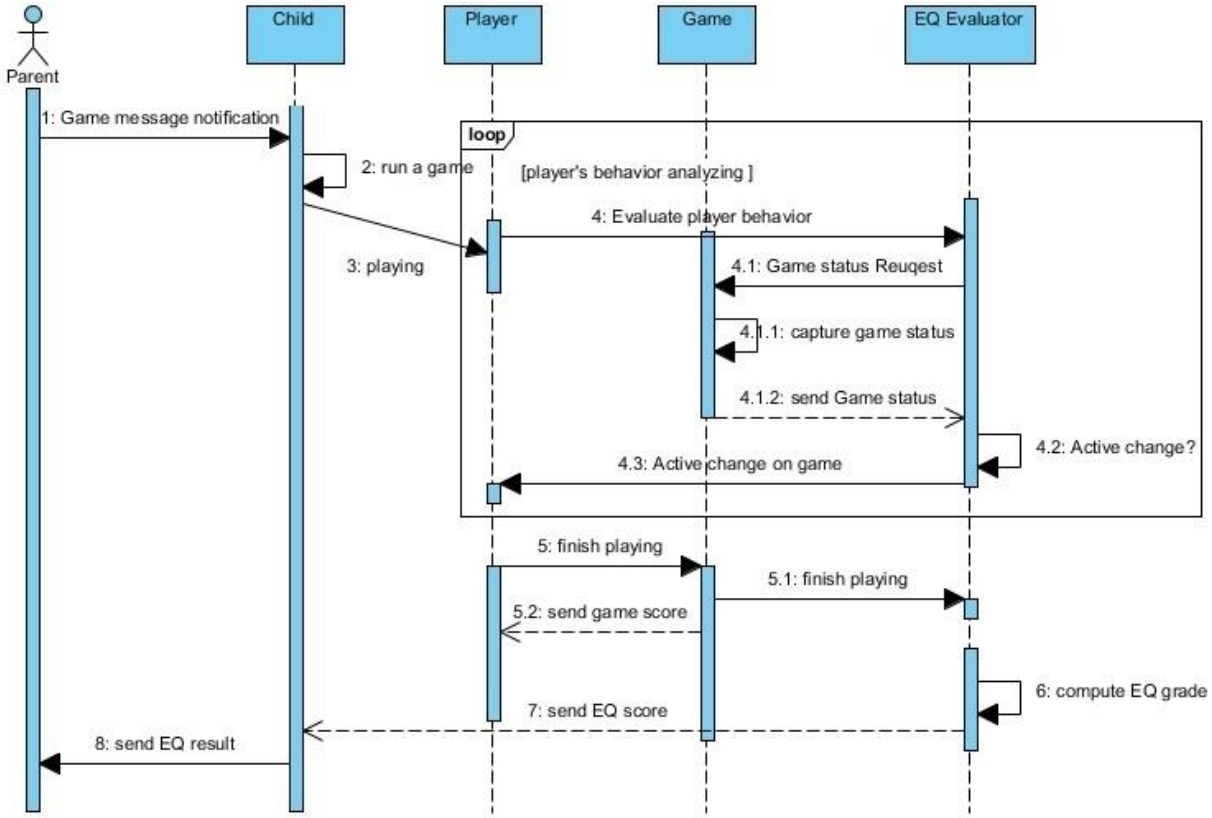



Fig.2. The interaction diagram of *Remote kid*

As illustrated in Fig.2, five major modules interact to each other to make *Remote kid* works as well. The Parent, Child, Player, Game, and EQ Evaluator. Obviously, except parent, the other modules are deployed in children application. In the following, each of the modules will be introduced.

**Parent** is an actor who should choose a game through parent application and send game notification to her/his children devices to start *Remote kid* mechanism (as shown in Fig.2), and finally, receive results notification from children application, which describes children's EI parameters. In fact, the quantitative factors are converted to qualitative metrics to be shown to parent.

**Child:** This module manages static parameters of child such as ID and the name of child, her/his parent etc. This module is responsible for receiving message notifications from parent application and sending EI results back to the parent application. Through child application, a game could not be launched directly.

**Player:** This module contains dynamic information of child while playing a specified game. As our game must evaluate child's EI, this module invokes EQ Evaluator methods to analyze child behavior during game play. EQ evaluator may need to make some changes on game scenario while child is playing, based on her/his feedback. So, Player represents this ability too. Regarded to reporting scores to the child, this module also shows the attained score from the game.

**Game**: This module consists of information associated with games. The Game module contains main variables which describe status of the game and player's activities during game play. This module sends game status to EQ evaluator to help it analyze the EI. In addition, if EQ evaluator decided to make changes on game, it could trigger the Game module via an event. At the end of the game, based on child activities, the child score is calculated and returned to be shown on application GUI.

**EQ Evaluator**: The main module of *Remote kid* which has to evaluate EI parameters of player is EQ evaluator. It consists of functions that could be overwritten to evaluate EI parameters with respect to each game. When Player sends request to an instance of this module, it asks Game instance to return game status. It analyzes the game status variables and based on game relevant thresholds, decides to change the scenario of the game. In fact, these changes are a kind of feedback to child actions to evaluate the EI parameters more precisely. Finally, when the game finishes (which is an event), the EI parameters are calculated and returned to Child module.

# 5. Case study: *Colorful Sounds* game

Main aspects of EI factors, namely intrapersonal intelligence, adaptability and general mood which are three of five basic EI aspects in Bar-On model [15], have been considered in this case study. So, a simple game, i.e. *Colorful Sounds*, is developed to allow the children to learn and practice the above mentioned capabilities. We concentrate on 4-6 years old children.

## 5.1 The game scenario

*Colorful Sounds* game is based on the idea of a musical game. In fact, we engage both the audiometric and color perception together in the game. Regarding Goller et al. research [17] which introduces the concept of Auditory-Visual synesthesia and its effects on brain, we assume some colored buttons each one playing a short sound after being pressed. Mapping between sounds and color buttons is part of the game. There are some games that let children make sounds themselves. In *Colorful Sounds* game, for the first time, the combination of memorizing the sounds and then playing the music is considered. The former music-based games just let children to make sound themselves without any challenges and even scenario. However, *Colorful Sounds* game has a scenario to lead child first memorize the sounds and then create listened sounds. So this game not only improves child auditory memory, but also tries to improve above mentioned EIs factors too.

The scenario of the game is as bellows: At first, a music which contains some short sounds (e.g. three parts) is played by pressing a button. Then, child should memorizes played music and try to build it by pressing different colorful buttons each one associated with a short sound. Child can know the validity of her/his answer from the game reactions. Fig.3 shows a screenshot of *Colorful Sounds* game.


Fig.3. screen shot of *Colorful Sounds* game

## 5.2 Evaluating Emotional Intelligence

As mentioned before, our main goal for designing this game is to improve child EI parameters. In this part we will explain how *Colorful Sounds* game improves and also evaluates intrapersonal intelligence, adaptability and general mood parameters.

Regardless of measurable parameters to evaluate IQ, EI mostly includes qualitative parameters which cannot be measured explicitly [2]. Furthermore, EI's standard exam tries to discover signs of emotional intelligence from behavior (which has its own difficulties for children). However, *Colorful Sounds* game defines some indicators for evaluating child behavior quantitatively. Table 1 represents some defined indicators for grading child's EI level. Based on *Colorful Sounds* game properties, some thresholds considered for each indicator such as $t_{play}$ which is limited to 5 minutes in each level, or as there is eight colored buttons, the minimum value of $N_{colored\_btns}$ set to eight. In the following, the way of using indicators will be explained.

Table1- some defined indicators in *Colorful Sounds* game for evaluating child's EI

| indicator | description | thresholds |
|---|---|---|
| $t_{play}$ | The time which player spends on playing the game for each level (minute) | $t_{play}^{min}=1$<br>$t_{play}^{max}=5$ |
| $t_{change\_music}$ | Time past from starting the game to pressing "change music" button to change intended music (minute) | $t_{change\_music}^{min}=2$ |
| $N_{colored\_btns}$ | number of clicks on colored buttons (the buttons that each one plays a short sound) | $N_{colored\_btns}^{min}=8$<br>$N_{colored\_btns}^{avg}=30$ |
| $N_{check\_ans}$ | number of times that "check answer" button is clicked | $N_{check\_ans}^{min}=1$<br>$N_{check\_ans}^{avg}=4$ |
| $N_{listen}$ | number of times that "listen music" button is clicked to hear the sound created by her/himself. | $N_{listen}^{min}=3$<br>$N_{listen}^{avg}=6$ |
| $N_{play}$ | number of times that "play music" button clicked to hear intended music | $N_{play}^{min}=1$<br>$N_{play}^{avg}=3$ |
| $N_{wins}$ | Number of times that player attains correct answer | $N_{wins}^{max}=4$ |
| $N_{fails}$ | Number of times that player fails to answer correctly | $N_{fails}^{min}=2$<br>$N_{fails}^{avg}=6$ |
| $M_{opt}$ | Optimism measurement | $M_{opt}^{avg}=3$ |

As Proposed, equation (1) represents how the indicators defined in table 1 can be used to assess the players' EI.

$$S_{EI} = \Sigma_{i=1}^{number\ of\ indicators} \alpha(i) * w(i) \quad \alpha \in \{+1, -1\}, \ w(i) \in \{1,2,3\} \qquad (1)$$

where $\alpha$(i) represents the impact of the $i^{th}$ indicator on EI (positive or negative) and w(i) demonstrates the weight of that indicator on score. In the following subsections, we describe the value of those factors for each EI measure.

### *5.2.1 Evaluating intrapersonal intelligence*

Intrapersonal intelligence refers to the ability to recognize and understand emotions as well as to express our feelings and how much we believe ourselves faithfully. It is divided to three subcomponents such as self-regard, self-actualization and emotional self-expression. In *Colorful Sounds* game, we mostly focus on self-regard which is defined as the ability to look inward and accurately perceive, understand and accept ourselves hopefully [15].

Cvencek et al. [18] state that self-regard cannot be measured explicitly, especially in children. Therefore, with respect to their evaluation, we also consider some implicit criteria. For example, more involving the child in the game and encouraging her/him to continue playing even when she/he cannot yield a good result, is a practice for improving child's self-regard.

To evaluate self-regard, based on its properties, some of mentioned indicators in Table.1 are used. Whereas, each considered indicator has a positive or negative impact with some weight on child self-regard grade, the way of considered indicators are listed in Table 2.

Table 2: The effect and weight of indicators for evaluating self-regard

| **Checking Conditions for indicator** | $\alpha$ | $w$ |
|---|---|---|
| $N_{fails} > N_{fails}^{avg}$ and $t_{play} > t_{play}^{avg}$ | +1 | 2 |
| $N_{fails} < N_{fails}^{min}$ and $t_{play} < t_{play}^{avg}$ | -1 | 1 |
| $N_{check\_ans} > N_{check\_ans}^{min}$ | +1 | 1 |
| $N_{fails} > N_{wins}$ and $t_{play} > t_{play}^{avg}$ | +1 | 2 |

### *5.2.2 Evaluating adaptability*

Adaptability presents the set of capabilities to identify and define problems as well as to generate and implement potentially effective solutions. Problem solving, reality testing and flexibility are considered in this component. Respect to previous studies [8] [7] we also focus on improving children's problem solving. This means children could have the ability to find causes, find solutions, and avoid problems during playing [15]. For example, if the time of pressing "change music" is less than the average of play time, it indicates a negative impact on problem-solving grade. The involved indicators are listed in Table 3.

### *5.2.3 Evaluating general mood ability*

General mood which is the ability to generate positive mood and be self-motivated is another basic component of Bar-On model. Flexibility, happiness and optimism are considered in the set of stress management parameters. *Colorful Sounds* game focuses on optimism and happiness from mentioned abilities. Optimism is defined as the ability to behave and think positively and to be hopeful even in the face of adversity. In addition, happiness combines self-satisfaction, general joyfulness and the ability to enjoy life [15].

As shown in Table 4, happiness mostly is evaluated by the time child spend on playing regardless of her/his results, and for optimism, a specific measurement is defined too. By

that, at first, one or more colored buttons are randomly chosen to be silent (needs to be pressed twice or more to play the sound). If the child keeps trying to press the silent buttons more than twice, then her/his optimism measurement is increased and some other random buttons are indicated for the next round to be silent. Table 4 shows the impacts/weights of relevant indicators.

Table 3: Indicators for evaluating problem solving

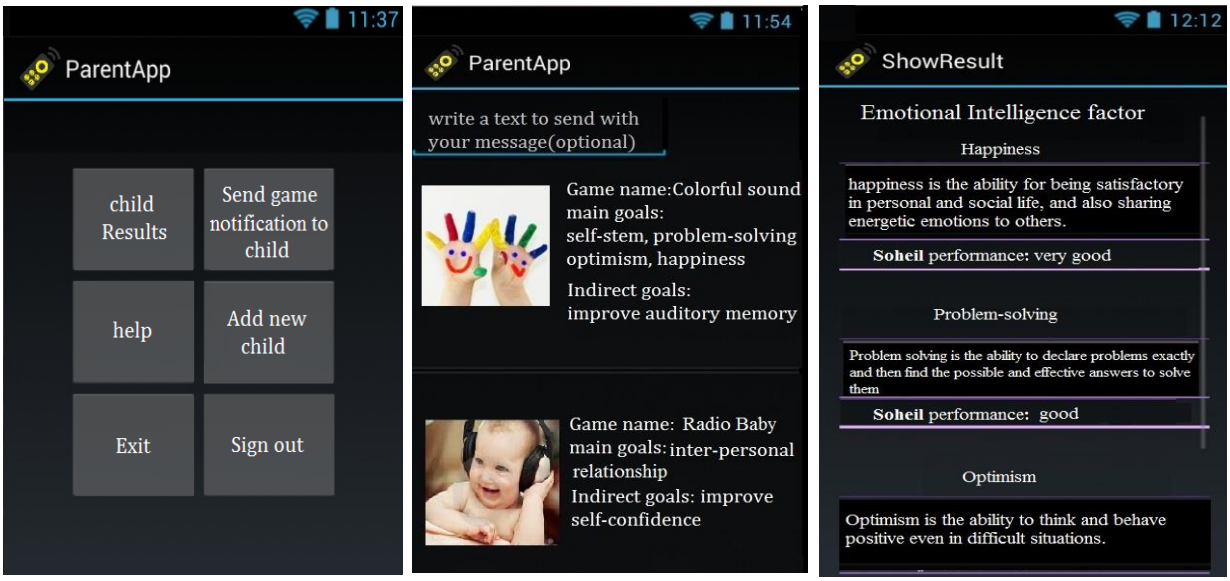
| **Checking Conditions for indicator** | $\alpha$ | $w$ |
|---|---|---|
| $N_{check\_ans} > N_{check\_ans}^{avg}$ and $t_{play} > t_{play}^{avg}$ | +1 | 2 |
| $N_{play} < N_{play}^{avg}$ and $N_{fails} > N_{fails}^{avg}$ | -1 | 2 |
| $N_{wins} = N_{wins}^{max}$ | +1 | 3 |
| $N_{listen} < N_{listen}^{min}$ | -1 | 1 |
| $N_{listen} > N_{listen}^{avg}$ | +1 | 2 |

Table 4: Indicators for evaluating general mood abilities

| **Checking Conditions for indicator** | $\alpha$ | $w$ |
|---|---|---|
| $t_{play} > t_{play}^{avg}$ | +1 | 2 |
| $t_{play} < t_{play}^{min}$ | -1 | 1 |
| $N_{colored\_btns} > N_{colored\_btns}^{avg}$ | +1 | 2 |
| $N_{play} < N_{play}^{min}$ | -1 | 1 |
| $t_{change\_music} > t_{change\_music}^{min}$ | +1 | 1 |
| $M_{opt} > M_{opt}^{avg}$ | +1 | 3 |

# 6. Evaluation results

To evaluate *Colorful Sounds* performance on children, we examined the game on a group of children consisting of ten 4-6 years old girls and boys. To address the aims outlined above (mainly improving children's EI) we test the EI of children before and after using *Colorful Sounds* for a while. In the following, the results will be explained. Moreover, GUI of parent application has been shown in Fig.4.




a) Parent app menu b) game list in parent app c) EI results in parent app

Fig 4. How to use *Colorful Sounds*: parent application

To test children's EI, there is a standard test recently introduced by researchers in Mehrafarin Consulting Center[3]. It is a manual test to evaluate children's EI based on Bar-on model. For more information, it contains different parts to evaluate child's EI level in each major component while she/he is playing a specific manual game. It takes fifteen minutes for each child to play the manual game under examiner's supervision, individually and with a partner, to examine both aspects of EI, i.e. interpersonal intelligence, intrapersonal intelligence. Examiner evaluates child's reactions to game and records them (via some notes). After all, in addition to recorded feedbacks of the child, she/he should answer some questions (14 questions) to examiner. Finally, the result of child's performance in EI will be presented in five main major components of EI to his/her parent.

So, to show *Colorful Sounds* effects on children's EI level, we test children twice with mentioned standard test. Once before using *Colorful Sounds* game, and once after using it for three weeks. As Fig. 5 illustrates, *Colorful Sounds* game, could improve children's Emotional Intelligence in three main components from Bar-on model i.e. intrapersonal intelligence, adaptability and general mood, in average.

[3] http://www.mehrafarincc.ir/

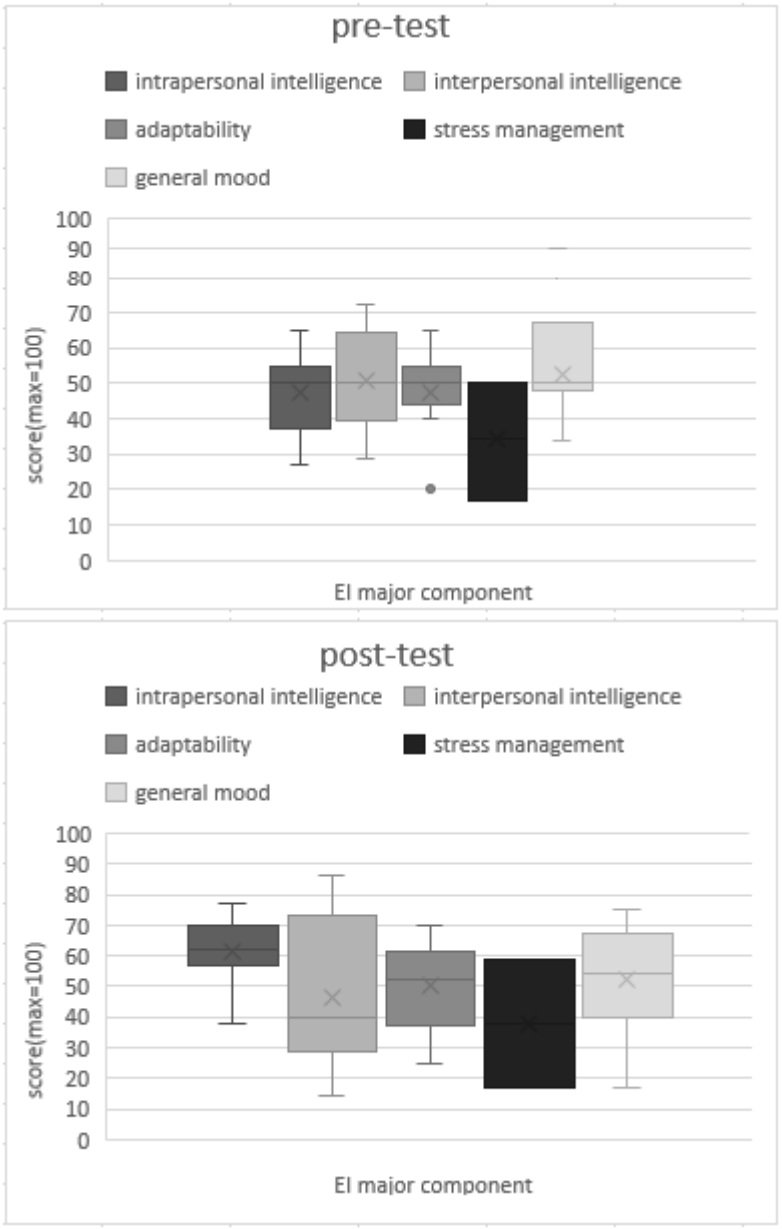



Fig. 5. Scores of pre- and post-tests

In Fig.5, the results have been presented in five different major of EI's component. Each of the major components of EI which examined separately in manual test has been shown via a colored box. The boxes show the minimum, mean and the maximum of the scores children taken in each mentioned EI component.

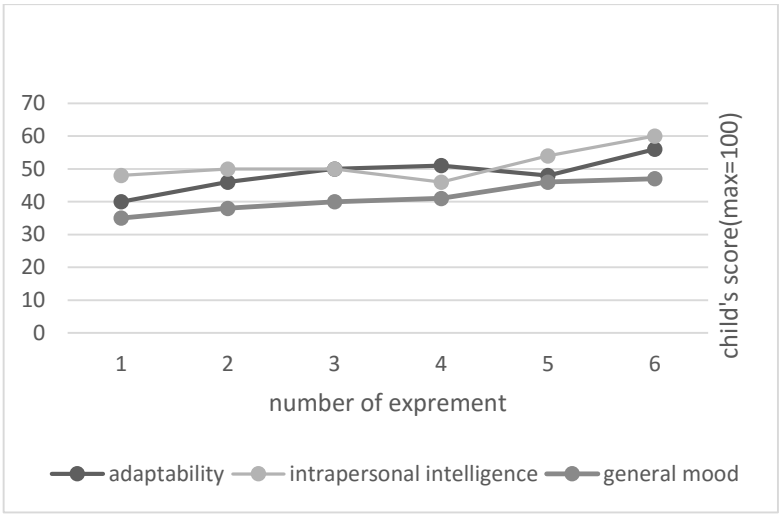
Comparison of pre- and post-test results in intrapersonal intelligence shows that the average of the score has been increased from about 48 to 62.

Adaptability that is shown by gray box (third box from left side) in Fig.5, has also been improved in average. Although the mean of results has not been changed much enough. This result indicates that as explained before, adaptability, and specially problem-solving abilities need more time to yield impressive impact on children [7] but still the improvement is considerable as shown in Fig. 5.

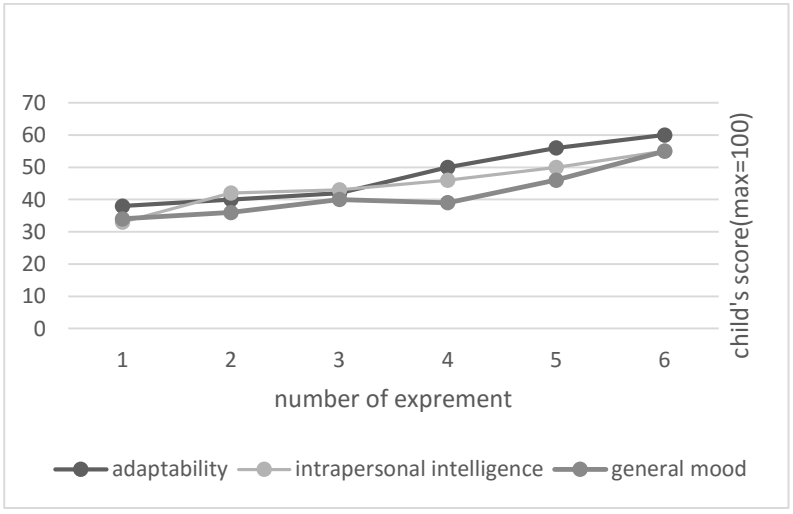
Last major component of EI is general mood which is shown by light gray box in Fig.5. The statistics reveal no significant difference on general mood of children and it is because of the nature of the parameters related to the set of general moods abilities [19].

More precisely, the impact of playing *Colorful Sounds* game on child to improve her/his general moods parameters such as happiness is affected immediately after playing the game. But still the increasing trend in the result cannot be ignorable.

On the other hand, we also examined the evaluation mechanism of *Colorful Sounds* game by recording the child's scores (as evaluated by EQ Evaluator) during some experiments. So, two random children are chosen as samples to show the effect of *Colorful Sounds* game on them during six trials. As Fig.6 illustrates, for both children, we have an increasing trend on their EI scores during playing the game. Since the results of EQ Evaluator are near to the results of manual test and both the manual test and the EQ Evaluator results show EI improvement on children after using *Colorful Sounds*, we can conclude that our evaluation model for EI parameters works properly.




(a)




(b)

Fig.6. EI scores of two sample child (a) and (b) graded by *Colorful Sounds* game (EQ Evaluator) during experiment

# 7. Conclusion

In this paper, we proposed a platform which allows developing useful learning games for children. *Remote kid* allows parents to connect their children's devices remotely and encourage them to play learning games. As a case we focus on improving children's EI and have developed *Colorful Sounds* game under this platform.

For this sample game, we defined some indicators to evaluate the EI and report it to parents. The children's result of game play can be accessible from the parent application. The results of testing *Colorful Sounds* on a small group of children show that our game could improve children's EI.

To yield more completed results, *Remote kid*'s game list must be promoted. Therefore, developing more learning games based on proposed platform is recommended as future work.

# 8. Acknowledgment

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