



EFFECTIVENESS OF A COMPUTER GAME FOR RECOGNIZING AND UNDERSTANDING FACIAL EMOTIONS IN HEARING-IMPAIRED CHILDREN

MOZHGAN GHANAT¹, ESMAEIL ZARAI ZAVARAKI¹, FATEMEH JAFARKHANI¹
& MORTEZA BAKHTIARVAND²

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¹Educational Technology, Department of Educational Technology, Allameh Tabataba'i University, Tehran, Iran

²Institute of Educational Science, Osnabrück University, Osnabrück, Germany

KORRESPONDENČNI AVTOR/CORRESPONDING AUTHOR
mozghan.ghanat@gmail.com

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Abstract/Izvleček

The present study evaluates the effectiveness of the EMOFIT computer game on the recognition and understanding of facially expressed emotions in 6-10-year-old hearing-impaired children. This quasi-experimental, pre-test-post-test design study, with control and experimental groups, was conducted with the participation of thirty children. The results showed significant improvement in emotion understanding, especially in adaptation (e.g., $\eta^2 = 0.84$), with slight improvement in naming (e.g., $\eta^2 = 0.57$). Results suggest that games like EMOFIT can effectively improve impaired social skills and emotional development among children.

Učinkovitost računalniške igre za prepoznavanje in razumevanje čustev pri otrocih z okvarami sluha

V študiji ocenjujemo učinkovitost računalniške igre "EMOFIT" pri prepoznavanju in razumevanju obraznih čustev pri otrocih z okvarami sluha, starih od 6 do 10 let. V kvaziekperimentalni študiji s pred- in potestom ter kontrolno in intervencijsko skupino (vsaka $n = 15$) je sodelovalo 30 otrok. Rezultati kažejo, da "EMOFIT" izboljšuje razumevanje čustev (npr. $\eta^2 = 0,85$), zlasti pri prilagajanju ($\eta^2 = 0,84$), medtem ko so izboljšave pri poimenovanju manjše ($\eta^2 = 0,57$). Ti izsledki poudarjajo potencial iger, kot je "EMOFIT", za izboljšanje socialnih veščin in čustvenega razvoja otrok z okvarami sluha.



Introduction

Emotion is a physiological response to specific events or situations, observable through changes in voice tone, facial expressions, body movements, or heart rate (Garcia-Garcia et al., 2022). Facial emotion recognition and understanding involve analysing facial movements and classifying them into interpretive categories, such as happiness, sadness, disgust, anger, fear, and surprise (Ekman & Friesen, 2003). These skills connect to John Miller's information processing theory, which says we use mental, internal, and social clues together to understand emotions and handle social situations (Garcia-Garcia et al., 2022; Jones et al., 2018).

Facial emotion recognition and understanding are critical for effective communication and social interaction. Impairment in these skills can lead to social communication difficulties, since they are closely linked to theory of mind and emotional intelligence (Torres et al., 2016). Emotional understanding is primarily acquired through interpersonal interactions, such as listening, observing, and participating in social exchanges (Soltaninejad et al., 2022). However, auditory impairment can disrupt these processes, leading to delays in emotional knowledge among hard-of-hearing (HoH) children (Ludlow et al., 2012).

HoH children often face challenges in recognizing and understanding emotions, owing to increased cognitive demands and atypical socialization of emotions (Lieu et al., 2020). They may also misinterpret facial expressions, which can affect their theory of mind and emotion regulation skills (Qi et al., 2024). While studies suggest that HoH children can distinguish between emotions, such children often struggle to understand emotions in specific contexts or to translate this ability into real-life performance, like talking with friends or family (Fayazi et al., 2021). These challenges may stem from delays in language acquisition and perceptual processing rather than auditory impairments alone (Dyck et al., 2004; Sidera et al., 2017).

Two hypotheses explain emotional recognition and understanding in HoH children. The deficit hypothesis posits that auditory deprivation during childhood leads to deficits in these skills, potentially due to language-based impairments or theory of mind deficits (Wiefferink et al., 2013). Conversely, the enhancement hypothesis suggests that HoH children may develop heightened sensitivity to emotional expressions because of their reliance on visual information and sign language (Hao and Su, 2014; Jones et al., 2018). For example, Hao and Su (2014) found that deaf children using sign language spotted emotions faster than hearing peers in some

tasks. But studies backing the deficit idea often miss how social settings affect emotional understanding (Cirasa et al., 2024).

Recent advances in educational technology have highlighted the potential of digital games to support emotional and social development in children with special needs. Papoutsis et al. (2022) demonstrated that digital games foster emotional connection and empathy, while Lee and Loo (2021) emphasized their role in improving emotional well-being in HoH children. However, few studies have explored the cognitive sequence of emotion recognition and understanding in this population.

This study addresses this gap by investigating the effectiveness of the computer game EMOFIT (Emotion-Focused Interactive Training) in enhancing facial emotion recognition and understanding in HoH children. Specifically, it poses this question: Can EMOFIT enhance HoH children's ability to recognize and understand facial emotions, compared to the effect of regular activities?

Literature Review

Recognition and Understanding of Facial Emotions in Children with Hearing Impairments

Research highlights that social media and digital tools can boost non-verbal communication and emotional learning in children with hearing impairments (HoH), supporting game-based interventions (Toofaninejad et al., 2017). Children with hearing impairments are often at risk of developing age-inappropriate socio-emotional competences due to challenges in recognizing and understanding non-verbal emotional cues (Tsou et al., 2021a). Emotional recognition and understanding are critical for interpreting others' actions, sharing emotions, and building interpersonal relationships. Impairment in these skills can lead to deficits in social interaction (Torres et al., 2016). Unlike neurological conditions such as autism, the difficulties faced by HoH children are primarily attributed to auditory impairment and delay in language acquisition rather than to structural brain abnormalities (Hong and Lv, 2025). Research indicates that HoH children often possess a smaller emotional vocabulary compared to their hearing peers, which can hinder their ability to interpret emotional language and social cues (Tsou et al., 2021a). For example, children with cochlear implants may recognize facial emotions but struggle to understand the emotional context of language (Sahana and Manjula, 2024). Additionally, HoH children may lack knowledge about the causes of emotions and social rules, leading to misinterpretation of emotional cues (Sidera et al., 2020).

Hearing impairment can also have long-term effects on cognitive development, particularly in emotional and situational contexts (Nikkhoo and Hassanzadeh, 2018). Tsou et al. (2022) found that HoH children exhibit deficiencies in recognizing complex emotions like sadness, which require significant mental representations. Eye-tracking studies reveal that these children often shift their attention from ambiguous information to more visually observable cues, suggesting a compensatory strategy to minimize misunderstandings in daily communication. This reliance on visual perception can serve as an effective pedagogical strategy, although there is no evidence to suggest that HoH children are inherently more inclined to learn visually than aurally (Shield et al., 2023). Still, some studies disagree; Jones et al. (2018) say dynamic visuals beat static ones for emotion recognition, but results vary. However, the small samples in Jones et al. (2018) limit generalizability, and small sample sizes in older studies further restrict what we can trust.

Dynamic visual stimuli are more effective than static ones in enhancing emotion recognition among HoH children, and increasing stimulus intensity improves performance in emotion detection (Jones et al., 2018). However, differences in teaching methods and cultural contexts can influence outcomes. For instance, East Asian children may experience higher emotional arousal when observing the emotions of others compared to Western children, which could mean games need cultural tweaks (Tsou et al., 2021a). Gender differences have also been observed, with HoH boys experiencing more socio-emotional difficulties than girls, suggesting games might need simpler design for boys (Laugen et al., 2016).

Computer Games and Children with Hearing Impairment

Digital games have emerged as effective tools for enhancing learning and emotional development in HoH children. These games provide detailed, realistic information and can improve visual-spatial attention, comprehension, and memory (Albash and Turkestani, 2023; Holmer et al., 2020). Interactive multimedia games, in particular, have been shown to enhance critical emotional and cognitive skills, including emotion regulation, empathy, problem-solving, and self-esteem (Kuo et al., 2024). The design of educational games for HoH children emphasizes clear on-screen text, visual cues, immediate feedback, and age-appropriate content (Melonio and Gennari, 2013). Action, adventure, and puzzle genres are particularly suitable for this population because of their simpler interaction mechanisms and narrative structures (Lotfi et al., 2014). Incorporating elements such as challenges, rewards, and fantasy can increase motivation and engagement (Cano et al., 2021).

Key factors in educational game design include the game objectives, mechanics, interaction, and narrative. Active and student-centred learning approaches are prevalent in game design for HoH children, with a focus on accessibility and engagement (Costa et al., 2019). Guidelines for designing accessible games include limiting on-screen information, maintaining an uncluttered layout, and minimizing distracting visual elements. Single-player games with progressive challenges and coherent information are preferred, since these reduce cognitive load and enhance focus (Chan et al., 2022; dos Passos Canteri et al., 2015a).

Although digital games have advanced learning for HoH children, few games focus on emotional recognition and understanding, which are key skills for their social development. This study bridges this gap by testing EMOFIT, a game designed to enhance facial emotion recognition and understanding in 6-10-year-old HoH children. Unlike broader digital tools, EMOFIT uses research-backed features, like visual cues and progressive challenges, to meet a specific need in HoH education, building on the visual learning strengths noted in prior studies (e.g., Jones et al., 2018; Tsou et al., 2021a).

Materials and Methods

Sample and Sampling Method

The study population consisted of hard-of-hearing (HoH) children aged 6 to 10 years undergoing speech therapy at two centres in Arak city. A purposive sampling method was used to select thirty participants, divided into two groups of fifteen each (intervention and control). The age distribution was as follows: eight children (26.7%) aged six, six (20%) aged seven, four (13.3%) aged eight, six (20%) aged nine, and six (20%) aged ten. The gender distribution included thirteen males (43.3%) and seventeen females (56.7%), with a mean age of 7.86 years (SD = 1.52).

Inclusion criteria included the following:

1. No additional disorders besides hearing impairment.
2. Average IQ.
3. Proficiency in Persian as a native language.
4. No familiarity with sign language.
5. No history of cochlear implantation.
6. Parents with normal hearing.

The sample size of thirty was limited by practical constraints, including restricted access to HoH children and challenges in controlling confounding variables, such as varying degrees of hearing loss (mild to profound), time since diagnosis (6 months to 10 years), and prior therapy exposure. This smaller sample was chosen to provide an initial exploration of EMOFIT's effectiveness, laying the groundwork for future studies with larger, more diverse populations. The gender distribution (56.7% female, 43.3% male) reflects the available participants at the centres, though gender effects were not a primary focus of this study. Some parents declined participation, which may introduce selection bias; moreover, data on non-participants were unavailable because of privacy restrictions. These limitations are further explored in the Discussion section, with plans for future research to increase sample size and balance gender to improve generalizability and statistical power.

Facial Emotion Recognition and Understanding Test

An online test based on Ekman and Friesen's (2003) images was used to assess facial emotion recognition. The test included thirty-six images representing six basic emotions: happiness, sadness, disgust, anger, fear, and surprise. The reliability coefficient was 0.85 (Tsou et al., 2021b), and its validity and reliability were confirmed in the Iranian cultural context.

The test comprised four components:

1. Differentiation: Identifying specific emotions from images (e.g., "Which picture shows someone happy?").
2. Naming: Labelling emotions displayed in images (e.g., "How does the man/woman look?").
3. Correspondence: Matching emotions to scenarios (e.g., "A boy/girl received a toy box as a gift. How do they feel?").
4. Adaptation: Inferring emotions from scenarios without explicit cues (e.g., "A child received a prize from their teacher/parent. How do you think the child feels?").

Each component included six questions, totalling twenty-four questions. The test was untimed and provided no feedback to avoid influencing responses. Reliability was assessed using Cronbach's alpha, and validity was confirmed through content validity (12 experts) and internal correlation validity (Pearson's coefficient > 0.7). Table 1 presents some of the scenarios utilized in the emotion correspondence and adaptation components.

Table 1.

Emotion Scenarios Approved by Experts in the Current Study Based on Prior Research (Dyck et al., 2004; Ziv et al., 2013)

Emotion	Correspondence Scenario	Adaptation Scenario
Sadness	The child's ice cream fell to the ground and melted. The child is sad. What does he look like?	The fish in the baby's aquarium have died. How do you think the child feels?
Happiness	The child received a toy box as a gift. The child is happy. What does he look like?	The child was given a prize by the teacher/their parents. How do you think the child feels?
Anger	The cat broke the grandmother's vase. The grandmother gets angry. What does she look like?	The children broke the neighbour's windows with a ball. How do you think the neighbour feels?
Surprise	A rabbit jumped out of the child's bag. The child is surprised. What does he look like?	A bunch of flowers came out of the child's pocket. How do you think the child feels?
Disgust	The child's hands were dirty before eating the apple. The child hates grime. What does he look like?	The bird has soiled the child's clothes. How do you think the child feels?
Fear	The child was left alone in a dark room. The child is afraid. What does he look like?	The bear is chasing the child. How do you think the child feels?

EMOFIT Game Design

EMOFIT, a puzzle-based computer game, enhances emotion recognition and understanding in HoH children through eight stages, each with five rounds, targeting four objectives: differentiation, naming, correspondence, and adaptation. Using a trial-and-error approach with four characters (mother, father, daughter, son), it aligns with design principles for HoH children (e.g., Melonio and Gennari, 2013; Chan et al., 2022) and educational game frameworks (Shi and Shih, 2015). Table 2 details its elements: a spinning wheel introduces six emotions individually; puzzles offer clear instructions and feedback (stars/stickers); screens minimize distractions, and a consistent layout tracks progress with stars, ensuring accessibility with culturally relevant scenarios for 6-10-year-old HoH children.

Table 2.*Review of EMOFIT Game Features Based on Design Elements of Digital Game-Based Learning*

Game Element	Module	Guidelines/Instructions	EMOFIT Implementation
Objectives of the Game	Gameplay and Instruction	• Present small amounts of information at a time. • Use informative and coherent images.	• Each emotion and scenario is presented individually with each wheel spin. • Puzzle pieces and symbols depict emotions and scenarios.
Game Mechanism	Gameplay and Instruction	• Provide clear objectives and instructions. • Offer immediate feedback. • Maintain consistent patterns and rules.	• Players assemble puzzle pieces to create emotions and apply them to scenarios. • Yellow stars and celebratory stickers reward success. • Mechanics remain consistent across stages.
Fantasy	Graphics and Interface	• Avoid vague or unfamiliar words. • Minimize distracting movement stimuli.	• Challenging words are minimized for clarity. • Puzzle screens are free from distractions.
Game Value	Training-Learning	• Use age-appropriate genres and images.	• Images and characters are suitable for the target age group. • Puzzles effectively convey concepts.
Player Interaction	Gameplay and Instruction	• Provide concise instructions and essential information. • Limit the number of choices.	• Scenario descriptions are concise. • Each wheel spin offers five random choices; each face requires three correct pieces.
Freedom	Training-Learning	• Use human-like avatars.	• The game features a family of four human characters.
Narrative	Graphics and Interface	• Maintain consistent item placement and combinations in the progress menu.	• Layout and colours are consistent across stages. • Progress menu displays stars collected.
Feeling	Gameplay and Instruction	• Focus on a single interactive task or communication channel at a time.	• Primary task: assembling emotions on the character's face using visual cues.
Challenges	Player/Learner	• Include progressive challenges with external rewards.	• Challenges progress from simple to complex (e.g., single-column to three-column puzzles).

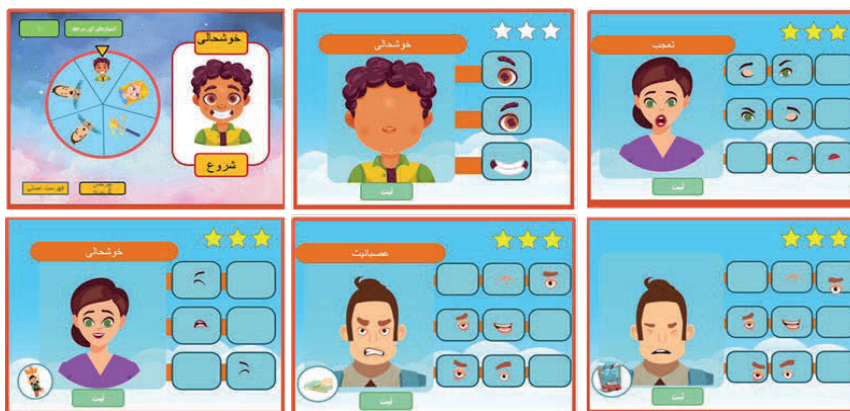
Social Aspects	Player/Learner	•Prefer games. •Aim for high-quality design.	single-player	•Players independently place puzzle pieces. •Scenarios are culturally relevant and grounded in real-life experiences.
Mystery/Puzzle-Oriented	Player/Learner	•Use visual cues or animation to direct attention to relevant information.		•Images depict scenarios; sentences describe scenarios from Stage 5 onward.

Game Mechanics, stages, and procedure

In EMOFIT, players select an emotion using a rotating wheel and assemble a matching puzzle, earning positive feedback like celebratory stickers for correct placements and yellow stars for completed puzzles, while incorrect attempts allow retries without penalties.

The game's eight stages progress across five rounds each: Stages 1–2 introduce six basic emotions with puzzles increasing from 3 to 6 pieces for differentiation; Stages 3–4 involve choosing correct pieces from a larger set to name emotions; Stages 5–6 require matching emotions to on-screen scenarios, and Stages 7–8 focus on inferring emotions from scenarios without direct cues. Developed on the Storyline platform, EMOFIT was evaluated by speech-language pathologists and educational technologists for clarity and usability, with Figure 1 showing stage examples and Figure 2 illustrating feedback for responses.

The study spanned six phases over five weeks, with twelve sessions of 30 minutes each. It began with Phase 1, a pre-assessment using the facial emotion recognition test, followed by Phase 2, where children adapted to the game after initial control struggles eased within two sessions. Phase 3 emphasized differentiation and naming, with peer assistance reflecting growing comfort, while Phase 4 introduced correspondence and adaptation, using pair or trio play to boost engagement. Phase 5 saw continued play with improved skills, and Phase 6 concluded with a post-assessment using the same test. The control group engaged in standard centre activities like speech therapy and group play without digital games, while the intervention group used EMOFIT on laptops. Initial challenges, such as mouse difficulties due to poor hand-eye coordination in five children and table height issues affecting three shorter participants, were addressed with touchpads and adjustable seating, minimizing disruption despite slight delays in early sessions. Therapists provided technical support without influencing emotional learning outcomes

**Figure 1.**

Top left: Display of the spinning wheel and selection of the emotion "happiness."

Top middle: The emotion "happiness" presented with a low level of challenge in stage 1.

Top right: The emotion "surprise" presented with a high level of challenge in stage 3.

Bottom left: The emotion "happiness" alongside a contextual cue in the bottom left corner of the image in stage 5.

Bottom middle: The emotion "anger" presented with a high level of challenge in stage 7.

Bottom right: The emotion "disgust" presented with a high level of challenge in stage 8.

**Figure 2.**

Left: Feedback after correctly constructing the emotion in the puzzle.

Right: Feedback image for an incorrect answer.

Results

Descriptive Statistics

Table 3 reports the means and standard deviations for facial emotion recognition and understanding components. In the pre-test, the experimental (n=15) and control (n=15) groups showed similar performance across differentiation (4.67 ± 0.98 vs. 4.00 ± 1.75), naming (3.67 ± 1.40 vs. 3.50 ± 1.15), correspondence (3.00 ± 1.69 vs. 3.40 ± 1.20), and adaptation (2.47 ± 1.13 vs. 2.80 ± 1.30). Post-test results revealed that the experimental group using EMOFIT outperformed the control group: differentiation (6.00 ± 0.00 vs. 3.80 ± 1.70), naming (5.13 ± 1.06 vs. 3.33 ± 1.11), correspondence (5.07 ± 0.80 vs. 3.27 ± 1.16), and adaptation (5.00 ± 0.53 vs. 2.60 ± 1.24). Total scores for emotion recognition (11.13 ± 1.06 vs. 7.13 ± 2.26) and understanding (10.07 ± 0.96 vs. 5.87 ± 2.07) also improved significantly. Skewness and kurtosis values (-2 to +2) confirmed normal data distribution.

Table 3.
Mean and Standard Deviation of Test Results

Components	Experimental (n=15)	Control (n=15)	Skewness	Kurtosis
Pre-test				
Differentiation	4.67 (0.98)	4.00 (1.75)	-0.51	-0.46
Naming	3.67 (1.40)	3.50 (1.15)	-0.05	0.40
Correspondence	3.00 (1.69)	3.40 (1.20)	0.203	-0.704
Adaptation	2.47 (1.13)	2.80 (1.30)	0.75	0.082
Emotion Recognition	8.23 (1.80)	7.40 (2.30)	0.13	-0.78
Emotion Understanding	5.47 (2.36)	6.10 (2.15)	1.14	0.42
Post-test				
Differentiation	6.00 (0.00)	3.80 (1.70)	-1.16	-0.026
Naming	5.13 (1.06)	3.33 (1.11)	-0.12	-0.98
Correspondence	5.07 (0.80)	3.27 (1.16)	-0.40	-0.94
Adaptation	5.00 (0.53)	2.60 (1.24)	-0.43	-1.29
Emotion Recognition	11.13 (1.06)	7.13 (2.26)	-0.44	-1.28
Emotion Understanding	10.07 (0.96)	5.87 (2.07)	-0.33	-1.35

Note: Skewness and kurtosis values ranged from -2 to +2, confirming data normality

Hypothesis Testing

Multivariate analysis of variance (MANOVA) tested the intervention's effects. Assumptions of homogeneity were met: Levene's test ($p > 0.05$) for variance and Box's M test ($p > 0.05$) for covariance matrices were non-significant.

Effect of EMOFIT on Emotion Recognition and Understanding

Wilks' lambda indicated a significant intervention effect on combined emotion recognition and understanding ($F=3.138$, $p=0.01$, Wilks' $\Lambda=0.246$). The experimental group showed significant gains in recognition ($F=109.098$, $p=0.001$, $\eta^2=0.80$, indicating a large effect) and understanding ($F=147.808$, $p=0.001$, $\eta^2=0.85$, indicating a large effect), explaining 80% and 85% of the variance, respectively.

Effect of EMOFIT on Emotion Recognition Components

Wilks' lambda confirmed a significant effect on recognition components ($F=54.143$, $p=0.01$, Wilks' $\Lambda=0.187$). The experimental group improved in differentiation ($F=41.19$, $p=0.001$, $\eta^2=0.61$, indicating a large effect) and naming ($F=35.36$, $p=0.001$, $\eta^2=0.57$, indicating a large effect), accounting for 61% and 57% of the variance, respectively.

Effect of EMOFIT on Emotion Understanding Components

Wilks' lambda showed a significant effect on the understanding components ($F=92.054$, $p < 0.01$, Wilks' $\Lambda=0.120$). The experimental group excelled in correspondence ($F=49.75$, $p=0.001$, $\eta^2=0.65$, indicating a large effect) and adaptation ($F=136.13$, $p=0.001$, $\eta^2=0.84$, indicating a large effect), explaining 65% and 84% of the variance, respectively.

Discussion*The Effect of EMOFIT on Facial Emotion Recognition and Understanding*

Findings show that EMOFIT significantly enhanced facial emotion recognition and understanding in hard-of-hearing (HoH) children ($n=30$), with a stronger effect on understanding, particularly adaptation ($\eta^2=0.84$). This success can be attributed to several factors:

Visual Symbols and Realistic Scenarios: The use of visual symbols tailored to each scenario aligns with previous research emphasizing the importance of visual aids in enhancing emotion recognition (Shield et al., 2023; Tsou et al., 2021b). Realistic and culturally relevant scenarios further contributed to the game's effectiveness (Holmer et al., 2020; Albash and Turkestani, 2023).

Cognitive Engagement: The game required children to form new cognitive associations to solve problems, reinforcing cognitive processing and aligning with findings by Cano et al. (2021). **Motivation and Engagement:** The interactive and engaging nature of computer games enhanced motivation, consistent with studies by Chan et al. (2022), Lee and Loo (2021), and El Mawas et al. (2019). **Design Principles:** The game adhered to the macro-design elements of educational games and followed a comprehensive framework for children with hearing impairments. Specific design guidelines, such as clear visual cues and progressive challenges, further supported its efficacy (Chan et al., 2022; Mascio et al., 2013; Melonio and Gennari, 2013). Future research should compare games designed with these principles to those without to further validate their effectiveness.

The Effect of EMOFIT on Facial Emotion Recognition (Differentiation and Naming)

EMOFIT notably improved recognition skills, especially differentiation ($\eta^2=0.61$), over naming ($\eta^2=0.57$). This aligns with studies showing that dynamic modes (e.g., games) are more effective than static modes (e.g., pictures) for emotion differentiation in HoH children (Dyck et al., 2004; Jones et al., 2018). The game's design minimized distractions and used clear, unambiguous patterns, optimizing performance in differentiation. The naming component showed less improvement, likely because of the game's focus on differentiation. However, the incorporation of progressive challenges and trial-and-error methods facilitated accurate emotion naming, guided by the modules on "Graphics and User Interface" and "Gameplay and Training" (Chan et al., 2022; dos Passos Canteri et al., 2015b).

The Effect of EMOFIT on Emotion Understanding (Correspondence and Adaptation)

The game exhibited a greater impact on understanding ($\eta^2=0.85$) than on recognition ($\eta^2=0.80$), consistent with studies by Ludlow et al. (2010). This finding contrasts with Ziv et al. (2013) but aligns with Fayazi et al. (2021), who found that associating emotions with specific situations enhances understanding. The adaptation component showed the most significant improvement, likely due to these three factors: **Culturally Relevant Scenarios:** The game incorporated scenarios aligned with the "play and learning" module and "contextual relevance" criterion (dos Passos Canteri et al., 2015b).

Age-Appropriate Challenges: The adaptation of challenges to the participants' age range positively influenced motivation and engagement. **Real-World Experiences:** The use of real-world experiences and visual symbols in later stages of the game enhanced emotional adaptation, as supported by Tsou et al. (2021b). This suggests the game's potential utility in speech therapy and special education settings. However, the small sample ($n=30$) and skewed gender distribution (56.7% female) may limit generalizability, since individual differences (e.g., degree of hearing loss, time since diagnosis) and selection bias from parental refusals could have influenced the results. Larger, balanced samples in future research will address these limitations.

Conclusion

This study examined the effect of EMOFIT on facial emotion recognition (differentiation, naming) and understanding (correspondence, adaptation) in thirty children with hearing impairments, aged 6 to 10. EMOFIT significantly enhanced these skills, with greater improvement observed in understanding ($\eta^2 = 0.85$) than in recognition ($\eta^2 = 0.80$). Among the subskills, adaptation showed the highest gains ($\eta^2 = 0.84$), likely due to the use of culturally relevant scenarios, while naming showed the least improvement ($\eta^2 = 0.57$). The program's success may be attributed to its educational design principles, culturally aligned content, and age-appropriate challenges, although prior training and therapist guidance may also have played a role. However, the study's generalizability is limited by factors such as the small sample size ($n = 30$), skewed gender distribution (56.7% female), potential selection bias due to parental refusals, and individual differences (e.g., degree of hearing loss, time since diagnosis).

As one of the few studies to examine these emotional skills in a cognitive sequence (from differentiation to adaptation) within this age group and cultural context, the findings support EMOFIT's potential application in speech therapy centres and special education classrooms to enhance social interaction skills. Future research should involve larger, more balanced samples to further explore inter-individual and cross-cultural differences.

Limitations and Future Directions

This study's sample of thirty participants from one cultural background, with a skewed gender distribution (56.7% female), selection bias from parental refusals, and unexamined individual differences (e.g., degree of hearing loss, time since diagnosis),

limits generalizability. Future research should use larger, more diverse samples across age groups beyond 6-10 years to test broader applicability. The intervention's long-term effects on real-world interactions remain unassessed, requiring follow-up studies at 3-12 months. Detailed design guidelines are also needed for inclusive games tailored to the needs of hearing-impaired children. Combining EMOFIT with behavioural therapy could enhance outcomes.

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Authors**Mozhgan Ghanat, M.A. in Educational Technology**

Department of Educational Technology, Allameh Tabataba'i University, Tehran, Iran, Dehkade-ye Olampik, Tehran, 1489684511, Iran, e-mail: mozhgan.ghanat@gmail.com, ORCID: <https://orcid.org/0009-0006-1274-9467>

Oddelek za izobraževalno tehnologijo, Univerza Allameh Tabataba'i, Teheran, Iran, Dehkade-ye Olampik, Teheran, 1489684511, Iran, e-pošta: mozhgan.ghanat@gmail.com, ORCID: <https://orcid.org/0009-0006-1274-9467>

Esmail Zaraii Zavaraki, PhD

Full Professor of Educational Technology, Department of Educational Technology, Allameh Tabataba'i University, Tehran, Iran, Dehkade-ye Olampik, Tehran, 1489684511, Iran, e-mail: zavaraki@atu.ac.ir, ORCID: <https://orcid.org/0000-0003-3584-4118>

Redni profesor izobraževalne tehnologije, Oddelek za izobraževalno tehnologijo, Univerza Allameh Tabataba'i, Teheran, Iran, Dehkade-ye Olampik, Teheran, 1489684511, Iran, e-pošta: zavaraki@atu.ac.ir, ORCID: <https://orcid.org/0000-0003-3584-4118>

Fatemeh Jafarkhani, PhD

Assistant Professor of Educational Technology, Department of Educational Technology, Allameh Tabataba'i University, Tehran, Iran, Dehkade-ye Olampik, Tehran, 1489684511, Iran, e-mail: fjafarkhani@atu.ac.ir, ORCID: <https://orcid.org/0000-0002-3052-3457>

Docentka za izobraževalno tehnologijo, Oddelek za izobraževalno tehnologijo, Univerza Allameh Tabataba'i, Teheran, Iran, Dehkade-ye Olampik, Teheran, 1489684511, Iran, e-pošta: fjafarkhani@atu.ac.ir, ORCID: <https://orcid.org/0000-0002-3052-3457>

Morteza Bakhtiarvand, PhD

Postdoctoral Researcher, Institute of Educational Science, Osnabrück University, Osnabrück, Germany, Seminarstraße 20, 49074 Osnabrück, Germany, e-mail: m.bakhtiarvand@atu.ac.ir, ORCID: <https://orcid.org/0000-0003-3853-5476>

Podoktorski raziskovalec, Inštitut za izobraževalne znanosti, Univerza v Osnabrücku, Osnabrück, Nemčija, Seminarstraße 20, 49074 Osnabrück, Nemčija, e-pošta: m.bakhtiarvand@atu.ac.ir, ORCID: <https://orcid.org/0000-0003-3853-5476>