pratica. Revista Multimédia de Investigação em Inovação Pedagógica e Práticas de e-LEARNING

PRATICA, VOL. 6 (3)
OUTUBRO 2023

A NEW EDUCATIONAL-DIDACTIC METHODOLOGY FOR PRESCHOOL AGED CHILDREN: THE DIGITAL MULTISENSORY STORYTELLING

UMA NOVA METODOLOGIA DIDÁCTICO-PEDAGÓGICA PARA CRIANÇAS EM IDADE PRÉ-ESCOLAR: A NARRAÇÃO DIGITAL MULTISSENSORIAL DE HISTÓRIAS

UNA NUEVA METODOLOGÍA EDUCATIVO-DIDÁCTICA PARA NIÑOS EN EDAD PREESCOLAR: LA NARRACIÓN DIGITAL MULTISENSORIAL

Elisabetta Tombolini[1]

Claudia Chierichetti[2]

Stefania Morsanuto[3]

[1] *Niccolò Cusano University, Italy, elisabetta.tombolini@unicusano.it*

[2] *Niccolò Cusano University, Italy, claudia.chierichetti@unicusano.it*

[3] *Pegaso Telematic University, Italy, Stefania.morsanuto@unipegaso.it*

Abstract

The learning process can benefit from the support of digital and multisensory components. Literature demonstrates how digital storytelling constitutes an educational and didactic model suitable to support engagement and active learning (O'Byrne et al., 2018). The integration of multisensory stimuli in learning contexts influences the strengthening of information in memory (Matos et al., 2015). Based on scientific evidence, this experimental quantitative research compares traditional storytelling, proposed to a control group, to digital multisensory storytelling, proposed to experimental group. The sample is composed by children between 3 and 4 years old. This study represents the progression of a previous research conducted on children of 5-years-old (Chierichetti & Tombolini, 2023). The aim is to investigate, with digital software EMOJ, the emotions elicited in children by the oral retelling of the story and to evaluate, with a recording protocol, the level of acquisition of information, in both groups. The results shows that the digital multisensory storytelling is linked to a higher ability to recall the story orally and to the implication of greater emotions in retelling phase.

Keywords: childhood, learning, narration, tecnology, emotion.

Resumo

O processo de aprendizagem pode beneficiar do apoio de componentes digitais e multissensoriais. A literatura demonstra como a narração de histórias digitais constitui um modelo educativo e didático adequado para apoiar o envolvimento e a aprendizagem ativa (O'Byrne et al., 2018). A integração de estímulos multissensoriais em contextos de aprendizagem influencia o reforço da informação na memória (Matos et al., 2015). Com base na evidência científica, esta investigação experimental quantitativa compara a narração de histórias tradicional, proposta a um grupo de controlo, com a narração de histórias digital multissensorial, proposta a um grupo experimental. A amostra é composta por crianças entre os 3 e os 4 anos de idade. Este estudo representa a progressão de uma investigação anterior realizada com crianças de 5 anos de idade (Chierichetti & Tombolini, 2023). O objetivo é investigar, com o software digital EMOJ, as emoções provocadas nas crianças pelo reconto oral da história e avaliar, com um protocolo de gravação, o nível de aquisição de informação, em ambos os grupos. Os resultados mostram que a narração digital multissensorial está ligada a uma maior capacidade de recordar a história oralmente e à implicação de maiores emoções na fase de recontagem.

Palavras-chave: infância, aprendizagem, narração de histórias, tecnologia, emoção.

Resumen

El proceso de aprendizaje puede beneficiarse del apoyo de componentes digitales y multisensoriales. La literatura demuestra cómo la narración digital constituye un modelo educativo y didáctico adecuado para apoyar el compromiso y el aprendizaje activo (O'Byrne et al., 2018). La integración de estímulos multisensoriales en contextos de aprendizaje influye en el fortalecimiento de la información en la memoria (Matos et al., 2015). Basada en la evidencia científica, esta investigación cuantitativa experimental compara la narración tradicional, propuesta a un grupo control, con la narración multisensorial digital, propuesta al grupo experimental. La muestra está compuesta por niños de entre 3 y 4 años. Este estudio representa la progresión de una investigación previa realizada con niños de 5 años (Chierichetti & Tombolini, 2023). El objetivo es investigar, con el software digital EMOJ, las emociones suscitadas en los niños por la narración oral del cuento y evaluar, con un protocolo de grabación, el nivel de adquisición de información, en ambos grupos. Los resultados muestran que la narración digital multisensorial está vinculada a una mayor capacidad para recordar oralmente el cuento y a la implicación de mayores emociones en la fase de relectura.

Palabras-clave: infancia, aprendizaje, narración, tecnología, emoción.

INTRODUCTION

Classic educational-didactic methodologies should integrate aspects of various natures in support of a quality learning process.

Storytelling is a narrative methodology based on shared reading by means of which information of various kinds are conveyed throughout the different levels of school education. Thanks to technological development, even within the educational landscape, digital tools have been introduced in order to support an acquisition process (Tisza & Markopoulos, 2021). In addition, educational environment must consider the multiplicity of stimuli of a different sensory nature. In fact, students have to daily decode, even unconsciously, this multiplicity that brings an additional value to learning processes (Li & Deng, 2022).

Considering the set of these different components, studies propose the use of an integrated educational-didactic methodology, digital multisensory storytelling. It emerges how the implementation of this new kind of methodology is linked to the improve of the level of information's acquisition and to a greater emotional activation in 5-year-old children (Chierichetti & Tombolini, 2023).

1 THE EVOLUTION OF STORYTELLING

Storytelling is a methodology that uses narrative to give meaning and significance to reality. In fact, telling children stories helps them understand the world and learn about the culture they belong to (Catalano & Catalano, 2022). Shared reading experiences enables children to acquire language skills and to develop emotional literacy. Stories illustrate abstract concepts in a way that makes them more concrete and accessible. When we listen to stories, some areas of the brain, related to cognitive control (Lehne et al., 2015), emotions (Hsu et al., 2015) and empathy, activate as if the subject is experiencing them, contributing to the mental reconstruction of the narrative (O'Byrne et al., 2018).

To date, the nature of storytelling is changing by virtue of emerging digital tools, so that they have given rise to digital storytelling (Di Fuccio et al., 2016). The use of technological tools creates dynamic learning contexts since they support the maintenance of attention and encourage student's engagement (Tisza & Markopoulos, 2021). Therefore, digital storytelling represents a narrative that originates from the combination of texts, recorded voices, music, sounds, images and videos. It makes learning context more communication and exciting, so that it engages students, increasing internal motivation to learn and concentration level. In addition, it supports understanding of concepts, registering a positive effect on learning of disciplinary content (Merjovaara et al., 2020).

The potential inherent in digital storytelling can be enhanced if integrated with additional stimuli of a multisensory nature. In fact, it has been shown how, in learning environments where the senses are stimulated simultaneously,

subjects with intellectual disabilities show an improvement in information acquisition (Matos et al., 2015). Since the learning process is transversal to all individuals, it is hypothesized that the integration of stimuli of a multisensory nature to digital storytelling could increase the quality of learning outcomes.

2 THE MULTISENSORY PROCESS OF STIMULI

Multisensory processing allows the analysis and the integration of information from the various sensory domains. As the nervous system grows and matures, the individual can simultaneously and functionally integrate information from different sensory systems (Sarko et al., 2012). Sensory signals convey, in addition to information of a descriptive nature of the surrounding environment, important features related to the emotional aspect of stimuli, completing and enriching the process of perception. The activity of amygdala allows the integration of multisensory information related to the physical characteristics whit the one of emotional nature (Domínguez-Borràs et. al, 2019). In addition, functional neuroimaging data show how this hub plays a potential role in the multimodal integration of emotional signals. Moreover, it is demonstrated how the activity of this hub is increased in the case of congruence of sensory stimuli with emotional value (Domínguez-Borrà et al., 2019).

It follows how the learning process must consider the importance acted by multisensory contexts. It emerges that compared to a *unisensory* presentation, a multisensory context with the presence of congruence of stimuli improves performance (Li & Deng, 2022). The integration of emotional signals from both visual and auditory modes of perception (Dong et al., 2022) enriches the perceptual process. As regarded the sense of smell, it is related to information learning that allow to increase the individual's cognitive heritage (Poncelet et al., 2010). In fact, odors influence mood, lead the individual to experience states of alertness or relax, and evoke memories. The enactment of this complex set of capabilities is linked to the emotional and olfactory processes sharing activation mechanisms by the same limbic regions which are fundamental in the generation of emotion-based behavior (Jean Ayres, 2012).

3 RESEARCH

The sample is composed by 32 children between 3 and 4 years old, divided in 44% male and 56% female. Sample is randomly assigned to a group (EG n=22; CG n=10): the experimental with digital multisensory storytelling and the control with storytelling. In both cases, the book "The Three Little Owls" was used, which is focused on the theme of attachment, and the same narrative voice was adopted.

In the experimental group, the story was projected on a neutral wall with a video that turns out of the same images from the book in animated form. In order to create a totally immersive surrounding environment and recreate the setting of the narrative, lights depicting the stars and moon were projected inside a suitably darkened room. In addition, olfactory stimuli were presented with the characteristic smell of pine. As an auditory stimulus, a musical background of the wood at night and the cry of the owl was played,. The owl was the protagonist animal of the story. Once the children entered the room, they placed themselves on a structure visual and tactile recalling the wood floor. So, the set of stimuli were proposed in order to solicit the simultaneous activation of different sensory channels, determining the multisensory component. Differently, in the control group, the story was read and, at the same time, the book's illustrations were shown to the children. Following the presentation of the story, the administration phase began. An experimental protocol was created to carry out this study. EMOJ is a software, realized in 2017 by the Polytechnic University of Marche, which detects in real time the emotions felt by the subject through the encoding of facial expressions and the analysis of related mimicry signs. The recording protocol was designed on the model of the test "M6 – Narrative Memory (MNa)", which is contained in the NEPSY-II test battery. The purpose was to assess narrative memory under two conditions, spontaneous and guided reconstruction: after listening to the story, the child was asked to repeat it freely; then, he or she was asked questions, belonging to the recording protocol, to guide the recall of information that did not emerge during the spontaneous retelling.

3.1 DATA ANALYSIS

The sample is divided between males and females as shown in Graph 1.

Graph 1

Sample gender

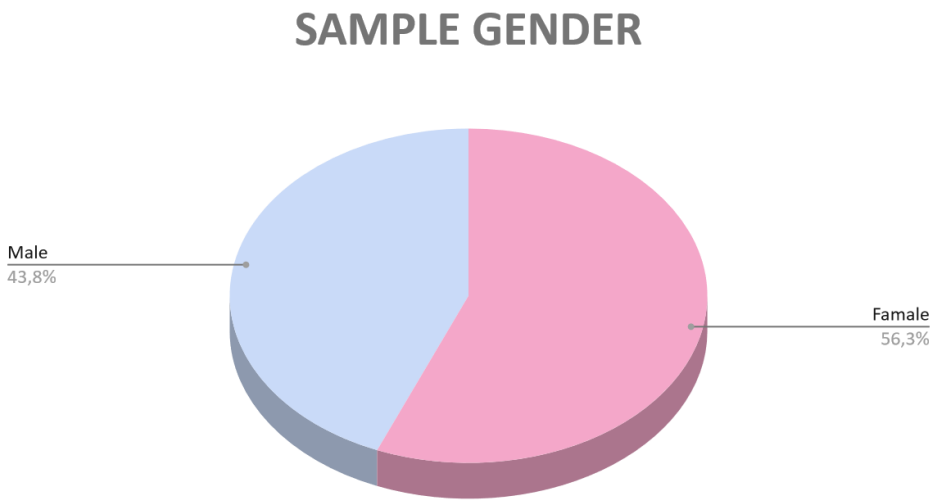


Table 1

Descreptive statistic

	DMS	ST
Numerosity	22	10
Average	18.3	13.4
Median	18.0	13.0
Standard Deviatioon	1.59	1.7
Minimum	16	12
Maximum	21	15

Note. DMS indicates Digital Multisensory Storytelling; ST indicates StoryTelling

The above Table 1 shows the descriptive statistics for two groups (digital multisensory storytelling, DMS and storytelling, ST); specifically, the central tendency and variability indices are shown. In order to perform the statistical analyses, JAMOVI software (version 2.3.26) was used. For data analysis, the Independent Samples T-Test was used,

which can be used by having a qualitative independent variable (storytelling methodology) with 2 categories: digital multisensory storytelling (DMS) and storytelling (ST). The necessary applicability conditions of the test were met by the data in the present study: independent observations, normality and homogeneity. The normality hypothesis was tested by the Shapiro-Wilk test (Table 2), which was not significant (p value > 0.05). Homogeneity was tested by Levene's test (Table 3), which was not significant (p value > 0.05). Therefore, the assumptions of normality and homoscedasticity were met.

Table 2

Shapiro-Wilk Test

	W	p
Results	0.943	0.089

Table 3

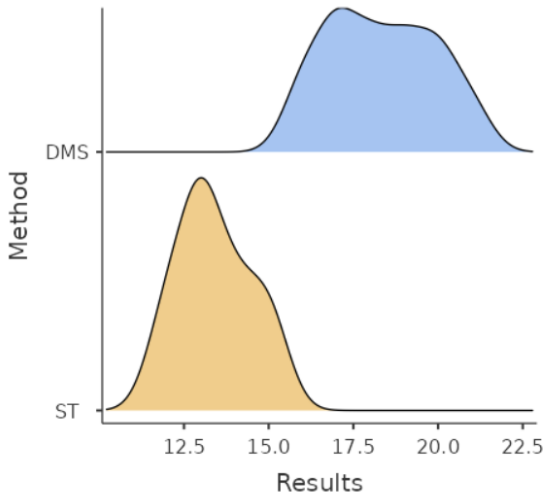
Leven's Test

	F	gdl	gdl2	p
Results	2.90	1	30	0.099

These respected conditions are also visible in the density Graph 2 below, in which the distributions of the scores obtained by the two groups are shown.

Graph 2

Density graph



Note. DMS indicates Digital Multisensory Storytelling; ST indicates StoryTelling

The independent-samples t-test was used to analyze the data and compare the results obtained in the control and experimental groups. Statistical significance (α) was set p < 0.05 (Table 4).

Table 4

Independet Sample T-Test

	Statistics	gdl	p		Effect size
Results t di Student	8.89	30.0	< .001	d di Cohen	0.099

Note. $H_a \mu_{DMS} \neq \mu_{ST}$

The averages identified in the two groups differed from each other in a statistically significant way (t_{30} = 8,89; p < .001), the p-value being below the level of significance (α). So, such sample data allow us to accept the experimental hypothesis. In addition, Cohen's d was used to determine the effect size for the pairwise comparisons made, which can be interpreted as small (0.20 ≤ d < 0.50), moderate (0.50 ≤ d < 0.79) and large (d ≥ 0.80). This index is large (d = 3.39), showing an important effect of the independent variable, namely methodology, on the dependent one, represented by learning outcomes. In addition, we used factorial ANOVA, having two independent variables (method and gender), both with two levels (DMS-ST and F-M, respectively) and one quantitative dependent variable, represented by learning outcomes. A requirement for the ANOVA test is that the variances of each comparison group are equal. This condition is tested using the Levene's statistic (Table 5). As the p-value > 0.05, the homogeneity of the variances was tested.

Table 5

Leven's Test

	F	gdl	gdl2	p
Results	2.90	1	30	0.099

Thus, we performed the factorial ANOVA.

Table 6

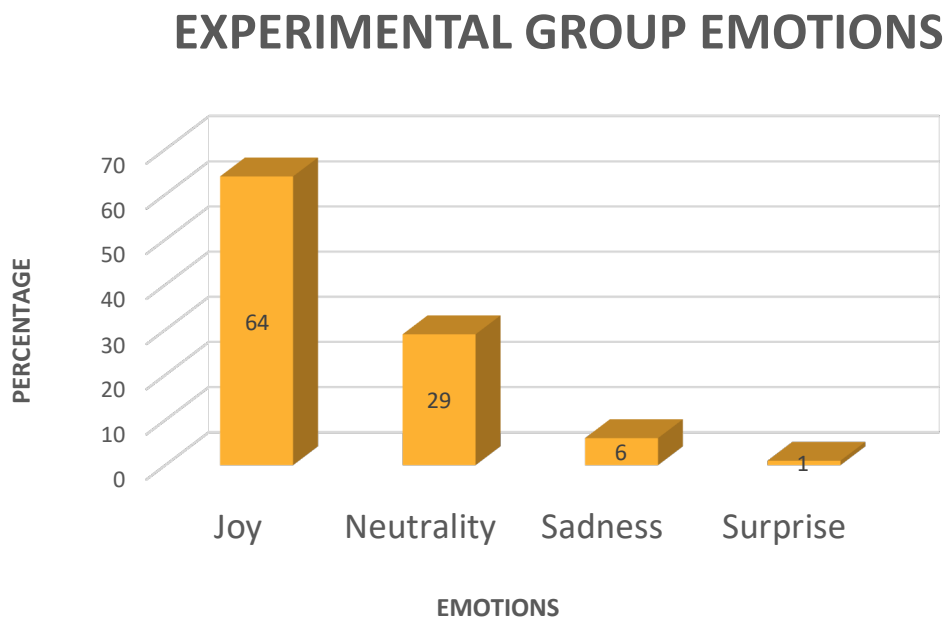
ANOVA Test

	Sum of squares	gdl	Mean square	F	p
Gender	0.6404	1	0.6404	0.2868	0.597
Method	165.8404	1	165.8404	74.2610	< .001
Gender * Method	0.0590	1	0.0590	0.0264	0.872
Residuals	62.5299	28	2.2332		

As evident in Table 6, the method factor ($F_{1,28}$ =74.2610; $p < 0.001$) provided a statistically significant result, showing a difference in the results between the two methods, regardless of the gender of the subjects. Differently, the gender factor ($F_{1,28}$ = 0.2868; p=0.597) was not significant.

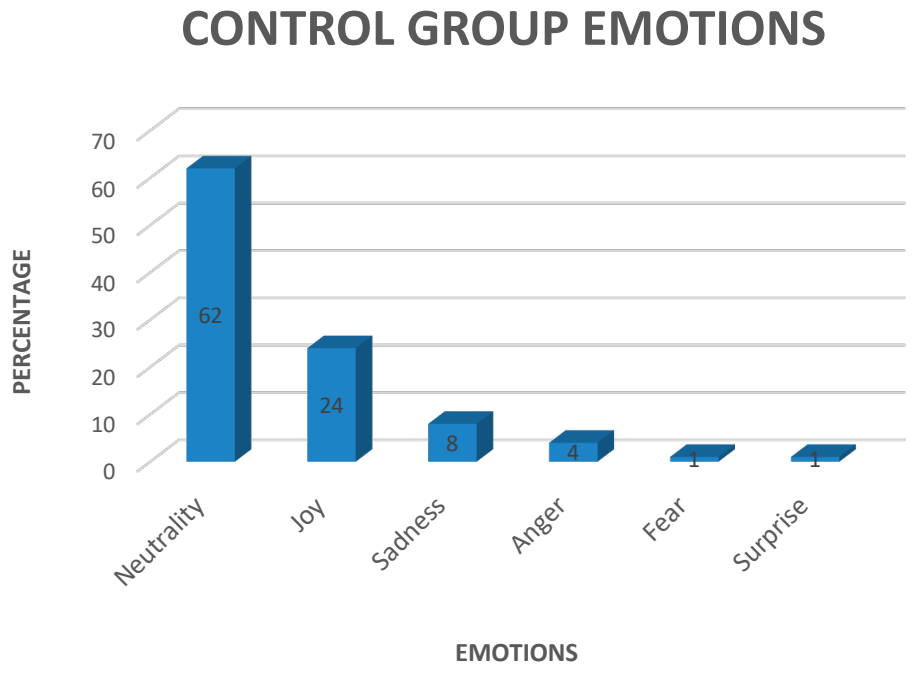
Graph 3

Experimental group emotion



Graph 4

Control group emotion



Graph 3 shows that in the experimental group the predominantly detected emotion, during the retelling phase, was joy (64%), followed by sadness (6%), surprise (1%). A neutral facial expression was found to be present at 29%. Graph 4 illustrates that the control group showed, during the retelling phase, a predominantly neutral facial expression (62%). In the presence of emotional activation, however, the emotions detected were joy (24%), sadness (8%), anger (4%), surprise (1%) and fear (1%).

3.2 DISCUSSION

The results obtained showed that the narrative methodology used influenced information acquisition in children: especially, children who participated in digital multisensory storytelling recalled more details regarding the story, compared with children who were recipients of conventional storytelling.

This result turns out to agree with the findings of the literature and in line with what was expected: the presentation of a story through a technological tool, combined with the integration of multisensory stimuli, had a positive effect on the memorization of the presented content. In addition, it was investigated whether these results were influenced by the gender variable. The results showed that the gender variable does not affect children's ability to recall in memory the salient points of the narrated story.

The second objective of the present work was to verify whether the subject was emotionally activated in the retelling phase, and if so, it was intended to assess the type of emotion predominantly experienced. Graph 4 shows that in the children who were the recipients of the storytelling, the presence of neutrality (62%) was detected, corresponding to an emotional state intensity of 0 and a totally neutral facial expression. In contrast, a higher level of emotional activation was recorded in the experimental group, amounting to a total of 71% (Graph 5). In both cases, the main emotion detected was joy, present at 64% in the children who participated in digital storytelling and 24% in who took part in conventional reading. The results showed that children, who were presented with digital multisensory storytelling, recorded higher abilities in recalling story details and higher emotional activation.

So, in agreement with the literature, these data demonstrated a good relationship between the level of information acquisition and the positive emotions experienced in the retelling phase. From this study, therefore, a close relationship emerged between narrative methodology and the acquisition of information, confirming that digital multisensory storytelling positively influences the ability to recall the story and a greater emotional activation in the retelling phase follows from it.

However, it would be essential to reproduce this research with a larger sample in order to determine a more stable relationship between the variables considered.

CONCLUSIONS

In conclusion, the results of our research support a previous study with a different aged group. These data underscore how there is an effectiveness of using digital and multisensory storytelling within childhood educational contexts in different level. So, this methodology is found to be functional in improving the level of information acquisition and emotional activation in children. It is necessary to mention some limitations of this study, such as the use of non-standardised and validated instrument, that is the recording protocol, and the limited sample size.

This work represents an initial study. The intention is to develop the research: (1) with the ultimate aim of developing a structured protocol, (2) with the use of digital devices, combined with various simultaneously stimulation thanks to the new collaboration between the HERACLE research laboratory and EASYLABS, which provides the SHX demotic console with environmental stimuli.

REFERENCES

Catalano, H. & Catalano, C. (2022), Using digital storytelling in early childhood education to promote child centredness, *ERD 2021 9th International Conference Education, Reflection, Development*. doi:10.15405/epes.22032.16.

Chierichetti C. & Tombolini E., (2023), Digital multisensory storytelling as educational-didactic methodology, *Italian Journal of Health Education*, *Sports and Inclusive Didactics*.

Di Fuccio, R., Ponticorvo, M., Ferrara, F., Miglino, O., (2016), Digital and Multisensory Storytelling: Narration with Smell, Taste and Touch, Lecture Notes in Computer Science, 9891, 509-512, https://dx.doi.org/10.1007/978-3-319-45153-4_51.

Domínguez-Borràs, J., Guex, R., Méndez-Bértolo, C., Guillaume Legendre, G., Spinelli, L., Stephan, M., Frühholz, S., Mégevand, P., Arnal, L., Strange, B., Seeck, M. & Vuilleumier, P., (2019), Human amygdala response to unisensory and multisensory emotion input: No evidence for superadditivity from intracranial recordings, *Neuropsychologia*, *131*, 9-24, https://doi.org/10.1016/j.neuropsychologia.2019.05.027.

Dong, H., Lil, N., Fan, L., Wei, J. & Xu, J., (2022), Integrative interaction of emotional speech in audio-visual modality, *Frontiers in Neuroscience*, 16, https://doi.org/10.3389/fnins.2022.797277.

Henriksen A., Katarzyna Topor M., Hansen R., Damsgaard L., Veber Nielsen A., Wulff-Abramsson A., Wienecke J., (2023), Virtual reality and embodied learning for improving letter-sound knowledge and attentional control in preschool children: A study protocol, *Computers & Educational: X Reality*, *2*, p. 100019.

Hsu, C. T., Jacobs, A. M., Citron, F. M., & Conrad, M. (2015), The emotion potential of words and passages in reading Harry Potter–An fMRI study. Brain Lang, 142, 96–114, https://doi.org/10.1016/j.bandl.2015.01.011.

Jean Ayres, A., Muratori, F. & Campatelli, G., (2012), I*l bambino e l'integrazione sensoriale. Le sfide nascoste della sensorialità*, Giovanni Fioriti Editore, Roma, p. 93.

Lehne, M., Engel, P., Rohrmeier, M., Menninghaus, W., Jacobs, A. M., & Koelsch, S. (2015), Reading a suspenseful literary text activates brain areas related to social cognition and predictive inference, *PLoS One*, *10*(5), https://doi.org/10.1371/journal.pone.0124550.

Li, J. & Deng, W. S., (2022), Facilitation and interference effects of the multisensory context on learning: a systematic review and meta-analysis, *Psychol Res.*, doi: 10.1007/s00426-022-01733-4.

Matos, A., Rocha, T., Cabral, L. & Bessa, M., (2015), Multi-sensory storytelling to support learning for people with intellectual disability: an exploratory didactic study, *Procedia Computer Science*, pp. 12-18, doi:10.1016/j.procs.2015.09.244.

Merjovaara, O., Nousiainen, T., Turja, L., & Isotalo, S. (2020), Digital Stories with Children: Examining Digital Storytelling as a Pedagogical Process in ECEC. *Journal of Early Childhood Education Research*, *9*(1), 99-123. https://journal.fi/jecer/article/view/114125.

O'Byrne, W. I., Stone, R., & White, M. (2018), Digital Storytelling in Early Childhood: Student Illustrations Shaping Social Interactions. *Frontiers in psychology*, 9, 1800, http://doi.org/10.3389/fpsyg.2018.01800.

Poncelet, J., Rinck, F., Bourgeat, F., Schaal, B., Rouby, C., Bensafi, M. & Hummel, T., (2010), The effect of early experience on odor perception in humans: Psychological and physiological correlates, *Behavioural Brain Research*, *208*(2), pp. 458-465, https://doi.org/10.1016/j.bbr.2009.12.011.

Sarko, D., Nidiffer, A., Powers, A. R., Ghose, D., Hillock-Dunn, A., Fister, M., Krueger, J., & Wallace, M. T., (2012), *Le basi neurali del processi multisensoriali*, CRC Press/Taylor & Francis, Boca Raton (FL).

Tisza, G. & Markopoulos, P., (2021), FunQ: Measuring the fun experience of a learning activity with adolescents, *Current Psychology*, 42, pp. 1936-1956, https://doi.org/10.1007/s12144-021-01484-2.