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INCLUSIVE MUSEUMS FOR WELL-BEING AND HEALTH THROUGH THE CREATION OF A NEW SHARED MEMORY

Design of inclusive paths into the museum for health and wellbeing promotion

Guidelines on the use of technological applications and tools

Co-funded by the European Union

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06.1 Design of inclusive paths into the museum for health and wellbeing promotion

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Guidelines for designing inclusive paths into the museum for health and wellbeing promotion

Introduction

Museums play a crucial role in fostering individual and community well-being through their rich cultural offerings. By adopting inclusive practices and leveraging digital innovations that align with a comprehensive definition of well-being—encompassing psycho-physical health, competencies for active citizenship, and emotional engagement—museums can enhance their contribution to visitor health and satisfaction.

This guide presents a strategic approach to designing inclusive museum paths that prioritize these aspects of well-being. It details how various technological tools and methodologies can be utilized to create engaging, accessible, and educational experiences. The guidelines cover a range of technologies, including those for personalizing tours, enhancing multimedia presentations, simulating real art, and incorporating sensory-based experiences. Additionally, they address the use of AI and other tools to study visitor emotions and preferences, ensuring that the museum environment supports both physical comfort and emotional enrichment.

By integrating technologies such as VR, interactive projectors, and digital storytelling, museums can provide personalized and immersive experiences that cater to diverse audiences. These approaches not only improve accessibility and learning but also foster a deeper emotional connection with the exhibits. The goal is to create museum spaces that are not only centers of learning but also promote personal growth, community engagement, and emotional well-being. Through thoughtful design and the continuous application of advanced tools, museums can evolve into inclusive spaces that enhance visitor experiences and well-being on multiple levels.

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Guidelines aligning with the threefold definition of wellbeing

1. Psycho-physical wellbeing

1.1 Accessibility and inclusivity

- **Physical access:** Ensure all museum spaces are accessible to people with physical disabilities. This includes installing ramps, elevators, and accessible restrooms.
- **Sensory access:** Implement tactile exhibits and audio descriptive guides to accommodate visitors with visual and auditory impairments.
- **Cognitive access:** Use simple, clear language in exhibits and provide alternative formats for visitors with cognitive disabilities.

1.2 Health and relaxation spaces

- Create quiet, relaxing areas where visitors can take a break. These spaces can have comfortable seating, soothing music, and nature-inspired decor to promote relaxation and stress relief.

1.3. Interactive and engaging exhibits

- Incorporate interactive elements that encourage movement and participation. For example, hands-on exhibits, interactive screens, and physical activities like scavenger hunts.

2. Wellbeing in terms of competencies for active citizenship

2.1. Educational programmes

- Develop workshops and educational programs that focus on the 4C skills: Communication, Collaboration, Critical Thinking, and Creativity.
- Encourage group activities that require teamwork, problem-solving, and creative thinking.

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2.2. Community involvement

- Host events that engage the local community, such as cultural festivals, art sessions, and public lectures. These events can foster a sense of community and belonging.
- Collaborate with schools and educational institutions to integrate museum visits into their curricula.

2.3. Technology integration

- Incorporate technologies to enhance the learning experience. Technological applications and tools can make museum visits more interactive and informative.
- Use technologies to provide personalized experiences and information, making the visit more engaging and tailored to individual interests.

2.4. Inclusivity in exhibits

- Ensure exhibits reflect diverse cultures, histories, and perspectives. This inclusivity can help visitors feel represented and respected, fostering a more inclusive society.

3. Wellbeing in terms of emotional engagement

3.1. Emotional connection through stories

- Use storytelling to create emotional connections with exhibits. Share personal stories, historical anecdotes, and cultural narratives that resonate with visitors on an emotional level.

3.2. Positive emotions and engagement

- Design exhibits and activities that evoke positive emotions, such as joy, curiosity, and wonder. Interactive exhibits, art installations, and immersive experiences can enhance emotional engagement.
- Incorporate elements that allow visitors to express their emotions, such as comment boards or digital platforms where they can share their thoughts and experiences.

3.3. Personalization

- Use technological applications and tools to provide customized recommendations and information based on visitor preferences and behaviors.
- Offer personalized tours that cater to specific interests, such as art, history, or science.

3.4. Supporting emotional wellbeing

- Provide activities that support emotional wellbeing, such as mindfulness sessions, art therapy workshops, and creative writing classes.
- Use the museum environment to create a sense of calm and inspiration, helping visitors to relax and rejuvenate.

4. Implementation strategies

4.1. Staff training

- Train staff and volunteers in inclusive practices to ensure all visitors feel welcome and supported.
- Provide sensitivity and empathy training to help staff understand and accommodate the diverse needs of visitors.
- Provide training for staff on how to use and troubleshoot emerging technologies, ensuring a smooth experience for visitors.

4.2. Pilot programs

- Start with pilot programs to test the technologies and methodologies, making adjustments based on visitor feedback before full-scale implementation.

4.3. Visitor feedback

- Collect and analyze visitor feedback regularly to understand their needs and improve the museum experience.
- Use surveys, suggestion boxes, and digital feedback platforms to gather input from a wide range of visitors.

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4.4. Continuous improvement

- Continuously update and improve exhibits and programs based on feedback and emerging best practices in museum education and inclusivity.
- Stay informed about new technologies and methodologies that can enhance the museum experience.

Indicative related resources

Ander, E., Thomson, L., Noble, G., Lanceley, A., Menon, U. & Chatterjee, H. (2011). Generic wellbeing outcomes: towards a conceptual framework for wellbeing outcomes in museums. *Museum Management and Curatorship*, 26:3, 237-259.

Ander, E., Thomson, L., Noble, G., Lanceley, A., Menon, U. & Chatterjee, H. (2013). Heritage, health and wellbeing: assessing the impact of a heritage focused intervention on health and wellbeing. *International Journal of Heritage Studies*, 19:3, 229-242.

Chatterjee, H. J., Vreeland, S. and Noble, G., 2009. Museopathy: Exploring the Healing Potential of Handling Museum Objects. *Museum and Society*, 7:3, 164-177.

Cotter, K.N. & Pawelski, J. (2021). Art museums as institutions for human flourishing. *The Journal of Positive Psychology*, 17.

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Diener, E. & Scollon, C. N. (2014). The what, why, when, and how of teaching the science of subjective wellbeing. *Teaching of Psychology, 41*(2), 175-183.

Foresight Mental Capital and Wellbeing Project. (2008). Final Project report. The Government Office for Science. London.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist, 56* (3), 218.

Friedli, L. (2012). *Social prescribing for mental health – a guide to commissioning and delivery*. Care Services Improvement Partnership, North West Development Centre.

Griffin, P. & Care, E. (2015). *Assessment and teaching of 21st Century Skills. Methods and Approaches*. Dodrecht: Springer Netherlands.

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McCroskey, J.C. & McCroskey, L.L. (1988). Self Report as an approach to measuring communication competence. *Communication Research Report*, 5:2, 108-113.

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Pietarinen, J., Soini, T., & Pyhalto, K. (2014). Students' emotional and cognitive engagement as the determinants of wellbeing and achievement in school. *International Journal of Educational Research*, 67, 40-51.

Poce, A. (2018). *Il patrimonio culturale per lo sviluppo delle competenze nella scuola primaria*. Milano: Franco Angeli.

Research Centre for Museums and Galleries (RCMG). (2003). *Measuring the outcomes and impact of learning in museums, archives, and libraries: The learning impact research project end of project paper*. RCMG.

Ryan, R. M. y Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic wellbeing. *Annual review of psychology, 52*, 141-166. doi:10.1146/annurev.psych.52.1.141

Sánchez-Elvira, A. (2004). Los pilares y recursos de la psicología positiva en el crecimiento personal. In M.Rodríguez Zafra (Ed.) *Crecimiento personal: Aportaciones de oriente y occidente*, (pp. 45-80). Desclée De Brouwer.

Scriven, M. and Paul, R. (1987). *Defining Critical Thinking*. 8th Annual International Conference on Critical Thinking and Education Reform.

Seligman, M. E. P. (2011). *Flourish: A visionary new understanding of happiness and wellbeing.* New York: Free Press.

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Stein, M.I. (1953). Creativity and culture. *The Journal of Psychology*, 36:2, 311-322.

Thomson, L., & Chatterjee, H.J. (2013). *UCL Museum Wellbeing Measures Toolkit*. London: UCL.

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Guidelines on the use of technological applications and tools

1. Technologies for personalising tours and recognising the most popular museum objects

1.1. Audioguides

How audio guides can contribute to health and wellbeing promotion

- Audioguides enhance the experience for visitors, allowing them to navigate the museum independently.
- They increase satisfaction, inclusivity, and emotional engagement by making exhibits more memorable and accessible.
- They encourage interest, motivation to learn, and a sense of self-exploration and self-accomplishment by personalising tours and helping visitors recognise the most popular museum objects.

Guidelines

- **Accessibility and inclusivity:** Ensure audioguides are available in multiple languages and formats, including audio descriptive guides for visually impaired visitors.
- **Ease of use:** Provide user-friendly devices or apps to minimize technical barriers and enhance visitor comfort.
- **Personalization:** Create customizable audioguides that allow visitors to select content based on their interests, thus enhancing satisfaction and inclusivity.
- **Emotional connection:** Develop engaging narratives that use storytelling techniques to create vivid mental pictures, and include emotional and cultural context to deepen visitors' connection to the exhibits. Include personal stories or testimonials related to the exhibits to evoke empathy and interest.
- **Collaboration across departments:** Develop scripts collaboratively across departments for comprehensive, informative and engaging content to foster long-term recollection and re-engagement.
- **Pre- and post-visit activities:** Use audioguides in conjunction with preparatory materials and follow-up activities to reinforce learning.

- **Educational and interactive content:** Include information that promotes understanding of cultural and historical contexts, and incorporate questions and prompts to engage visitors actively.

Indicative related resources

Cesario, V., Coelho, A., Nisi, V. (2017). Audio Guides and Human Tour Guides: Measuring Children's Engagement & Learning at a Museum Setting. *CHITALY 2017 At*: Cagliari, Italy, (1910).

Hutchinson, R., Eardley, A.F. (2021). Inclusive museum audio guides: 'guided looking' through audio description enhances memorability of artworks for sighted audiences. *Museum Management and Curatorship* 36(6).

Vallez, N., Krauss, S., Espinosa-Aranda, J. L., Pagani, A., Seirafi, K., & Deniz, O. (2020). Automatic Museum Audio Guide. *Sensors*, 20(3), 779.

1.2. Videoguides

How video guides can contribute to health and wellbeing promotion

- Videoguides improve accessibility and inclusion, and enhance the overall learning experience.
- They encourage interaction with exhibits, potentially encouraging movement and improving physical activity levels.
- They enhance satisfaction, interest, and motivation by offering a rich, multimedia learning experience.

Guidelines

- **Visual and audio integration:** Use multimedia content to cater to different learning styles, and improve retention.
- **Accessibility and usability:** Ensure devices are easy to carry and use, and provide alternatives for those who may not wish to download apps on personal devices.
- **Interactive storytelling:** Tell stories about exhibits that place visitors in historical or cultural contexts, making the learning experience more vivid and engaging. Incorporate interactive elements, such as choosing the next part of a story, encouraging visitors to participate and explore further.
- **Immersive experiences:** Integrate augmented reality (AR) and virtual reality (VR) elements to make the visit more interactive and engaging.

- **Problem-solving tasks:** Incorporate problem-solving tasks related to the exhibits, enhancing critical thinking and engagement.
- **Collaborative learning:** Design activities that visitors can complete together using videoguides, promoting teamwork and discussion.
- **Continuous improvement:** Use visitor feedback to refine and enhance the multimedia content.

Indicative related resources

Stock O. et al (2007) Adaptive, intelligent presentation of information for the museum visitor in PEACH. *User Modeling and User-Adapted Interaction*, 17(3), 257-304.

Zancanaro, M., Stock, O., & Alfaro, I. (2003). A multimedia museum guide with dynamic documentaries. Contesti culturali e fruizione dei beni culturali.

Sung, Y. T. *et al.* (2010). Mobile guide system using problem-solving strategy for museum learning: A sequential learning behavioural pattern analysis. *Journal of computer assisted learning*, *26*(2), 106-115.

1.3. Virtual Tours

How virtual tours can contribute to health and wellbeing promotion

- Virtual tours offer access to cultural experiences for individuals with mobility issues or those who cannot visit in person.
- They stimulate emotional engagement and provide a sense of presence and belonging.
- They facilitate self-exploration and learning, enhancing satisfaction, self-esteem and a sense of self-accomplishment.

Guidelines

- **Remote access:** Offer virtual tours for those who cannot physically visit the museum, ensuring they can still experience the exhibits.
- **Accessibility:** Provide virtual tours that are accessible on multiple devices, including desktops, tablets, and smartphones. Ensure the virtual tours are compatible with screen readers and other assistive technologies.
- **User-friendly design:** Ensure the virtual tours are easy to navigate and do not cause discomfort, such as motion sickness.
- **Immersive environments:** Use high-resolution images and 360° cameras to create detailed virtual tours that make visitors feel as if they

are physically present. Incorporate sound effects and interactive elements (e.g. clickable hotspots with additional information and audio commentary) to enhance immersion.

- **Emotional narratives:** Include narratives that evoke strong emotions and connect with visitors on a personal level.
- **Interactive learning modules:** Develop modules that allow visitors to explore and learn about exhibits in detail, including quizzes and reflection prompts.
- **Blended learning:** Combine virtual tours with in-person visits for a comprehensive learning experience.
- **Educational integration:** Use virtual tours as educational tools in classrooms to complement history and cultural studies.

Indicative related resources

Argyriou, L., Economou, D. & Bouki, V. Design methodology for 360° immersive video applications: the case study of a cultural heritage virtual tour. *Pers Ubiquit Comput* 24, 843–859 (2020).

Mah, O.B.P. *et al.* (2019). Generating a virtual tour for the preservation of the (in)tangible cultural heritage of Tampines Chinese Temple in Singapore, *Journal of Cultural Heritage* 39, 202–211.

1.4. Bluetooth and radio beacons

How bluetooth and radio beacons can contribute to health and wellbeing promotion

- Bluetooth and radio beacons help manage crowd density, improving safety and comfort for all visitors.
- They can also enhance satisfaction through personalized tours and efficient navigation.

Guidelines

- **Visitor flow management:** Use beacons to manage and analyze visitor flow to prevent overcrowding, and enhance the comfort and overall visitor experience.
- **Engagement tracking:** Use beacons to understand visitor interests and engagement patterns.
- **Behavioral insights:** Collect data on visitor movements to understand their preferences and improve exhibit placements and descriptions accordingly.

- **Personalized learning paths:** Use data from beacons to create personalized tour recommendations.
- **Interactive exhibits:** Develop exhibits that respond to visitor movements and interactions, creating a dynamic learning environment.
- **Privacy protection:** Ensure that visitor data is anonymized and protected to maintain privacy and visitor trust.

Indicative related resources

Balzotti, C., Briani, M., Corbetta, A., Cristiani, E., Minozzi, M., Natalini, R., Suriano, S., Toschi, F. (2018). Forecasting Visitors' Behaviour in Crowded Museums. *Proceedings from the 9th International Conference on Pedestrian and Evacuation Dynamics* (PED2018) Lund, Sweden – August 21-23.

Yoshimura, Y., Sobolevsky, S., Ratti, C., Girardin, F., Carrascal, J. P., Blat, J., & Sinatra, R. (2014). An Analysis of Visitors' Behavior in the Louvre Museum: A Study Using Bluetooth Data. *Environment and Planning B: Planning and Design*, 41(6), 1113–1131.

1.5. Virtual Museums

How virtual museums can contribute to health and wellbeing promotion

- Virtual museums provide remote access to cultural experiences, beneficial for those with access barriers (physical, geographical etc).
- They stimulate emotional engagement and provide a sense of presence and belonging.
- They facilitate self-exploration and learning, enhancing satisfaction, self-esteem and a sense of self-accomplishment.

Guidelines

- **Accessibility:** Make sure the virtual museum is accessible on multiple devices, including desktops, tablets, and smartphones. Provide virtual tours that are compatible with screen readers and other assistive technologies.
- **User-friendly design:** Ensure the virtual museum is easy to navigate and does not cause discomfort, such as motion sickness.
- **Multimedia integration:** Use a mix of text, audio, and video to cater to different learning styles.
- **Immersive environments:** Use high-resolution images and 360° cameras to make visitors feel as if they are physically present. Incorporate sound effects and interactive elements (e.g. clickable

hotspots with additional information and audio commentary) to enhance immersion.

- **Interactive learning modules:** Develop modules that allow visitors to explore and learn about exhibits in detail, including quizzes and reflection prompts.
- **Educational integration:** Use virtual museums as educational tools in classrooms to complement history and cultural studies.
- **Feedback and improvement:** Regularly update the content based on user feedback and emerging educational needs.

Indicative related resources

Atthasongkhro, J., Kanchanachaya, N., Nitjarunkul, N., Auksornnit, V., Tammachart, J. (2022). The Effect Of Using Virtual Reality Museum For Improving Learning Of The Users Of The Hall Of Southern Thai Culture, Princess Galyani Vadhana Institute Of Cultural Studies, Prince Of Songkla University. *BiblioMed*, 21(1), pp. 82-98.

Elbay, S. (2021). Distance education experiences of middle school 7th grade students in the Turkey during covid-19 pandemic: Virtual museum example. *Turkish Online Journal of Distance Education-TOJDE*, 23(1).

Jadán-Guerrero, J., Mendoza, M., Acosta-Vargas, P., Nunes, I. (2022). Digital Learning Experiences in Virtual Museums. In Isabel L. Nunes (Eds.), *Human Factors and Systems Interaction*. AHFE (2022) *International Conference. AHFE Open Access, 52. AHFE International, USA.*

1.6. Physical visits systems (iPad on wheels)

How physical visits systems (iPad on wheels) can contribute to health and wellbeing promotion

- Physical visits systems (iPad on wheels) facilitate remote access to museum experiences, promoting inclusivity especially for individuals with access barriers (physical, geographical etc.).
- They enhance engagement and inclusion by enabling interactive remote exploration.
- They support social interaction through remote guided tours and shared experiences.

Guidelines

- **Remote accessibility:** Use telepresence robots to provide remote access to exhibits, especially for those with mobility issues.
- **Ease of use:** Ensure robots are user-friendly and provide clear instructions for remote operation. Design intuitive interfaces for controlling the robots.

- **Inclusive experiences:** Ensure that remote visitors can interact with the exhibits and other visitors.
- **Capacity building:** Offer training sessions to cultivate digital skills and build confidence in using the technology.

Indicative related resources

Bagherzadhalimi, A., Di Maria, E. (2017). Design considerations for mobile robotic telepresence in museums - A report on the pilot users feedbacks. *Advances in Robotics, Mechatronics and Circuits.*

Lupetti, M. L., Germak, C., Giuliano, L. (2015). Robots and Cultural Heritage: New Museum Experiences. *Electronic Visualisation and the Arts (EVA 2015) (EVA) 7-9 july 2015.*

Trahanias, P. E., Argyros, A. A., Tsakiris, D. P., Cremers, A. B. (2000). TOURBOT-Interactive Museum Telepresence Through Robotic Avatars - Project Presentation and Prospects. Proceedings of the 9th Int. WWW Conf., Culture Track, Amsterdam, Netherlands, May 15-19, 2000.

Tsui, K. M., Dalphond, J. M., Brooks, D. J., Medvedev, M. S., McCann, E., Allspaw, J., Kontak, D., Yanco, H. A. (2015). Accessible Human-Robot Interaction for Telepresence Robots: A Case Study. *Paladyn, Paladyn, Journal of Behavioral Robotics.* 6, pp. 1–29.

1.7. Indoor GPS tracking systems

How indoor GPS tracking systems can contribute to health and wellbeing promotion

- Indoor GPS tracking systems assist in wayfinding, reducing physical strain and stress associated with navigation.
- They enhance satisfaction and reduce anxiety by providing clear navigation support.
- They encourage group visits by facilitating easier navigation for all members.

Guidelines

- **Integration:** Choose reliable and accurate GPS tracking solutions. Regularly maintain and update them to ensure accuracy and functionality.
- **Navigation assistance:** Provide accurate indoor maps and navigation assistance to help visitors find their way. Provide clear signage and instructions on using the system.
- **Interactive maps:** Create interactive maps that provide additional information about exhibits as visitors approach them.
- **Personalized experiences:** Use tracking data to offer personalized recommendations and learning paths.

- **Engagement analysis:** Use tracking data to understand visitor engagement and improve exhibit placement and visitor flow.
- **Privacy concerns:** Ensure that all data collection is consensual and secure.

Indicative related resources

Rains, T., Barros, J. (2011). Wayfinding and visitor tracking in museums: Accuracy assessments of hybrid positioning services. *Conference: International Symposium on Spatio-Temporal Analysis and Data Mining.*

1.8. A.I. - Robot guide interaction

How A.I. - Robot guide interaction can contribute to health and wellbeing promotion

- A.I. - Robot guide interaction lowers anxiety and increases enjoyment through engaging robot interactions.
- It enhances group dynamics by offering an interactive and collective learning experience.

Guidelines

- **Human-like interaction:** Design robots to be approachable and user-friendly, with human-like movements and speech to make interactions more natural and engaging. Train robots to recognize and respond to social cues.
- **Flexibility and adaptability:** Ensure robots can handle diverse visitor queries and adapt to different visitor needs.
- **Interactive educational content:** Program robots with comprehensive knowledge about the exhibits. Use robots to conduct interactive learning sessions where visitors can ask questions and receive detailed responses, promoting active learning.
- **Personalized interactions:** Develop AI algorithms that personalize the interaction based on visitor interests and past interactions.
- **Digital literacy:** Use robots to demonstrate the application of AI and robotics, enhancing visitors' understanding of contemporary technology.

- **Continuous improvement:** Regularly update the robot's content and capabilities based on visitor feedback and technological advancements.

Indicative related resources

Iio, T., Satake, S., Kanda, T. et al. (2020). Human-Like Guide Robot that Proactively Explains Exhibits. *International Journal of Social Robotics,* 12, pp. 549–566.

Shiomi, M., Kanda, T., Ishiguro, H., Hagita, N. (2007). Interactive Humanoid Robots for a Science Museum. *IEEE Intelligent Systems*, 22(2), pp. 25-32.

1.9. Chatbots

How chatbots can contribute to health and wellbeing promotion

- Chatbots reduce anxiety and increase satisfaction and enjoyment by providing instant and personalised support.
- They enhance emotional connection and engagement through interactive and responsive communication.

Guidelines

- **Integration:** Use chatbots to provide instant information, real-time feedback and support during museum visits.
- **Personal interactions:** Develop chatbots that can engage in personalized conversations with visitors, making their experience more interactive and enjoyable.
- **Engaging conversations:** Design chatbots to provide engaging and informative conversations for different audience segments.
- **User-friendly interface:** Ensure that chatbots are easy to interact with, especially for older audiences.
- **Educational games:** Integrate educational games and quizzes within the chatbot interactions to promote learning.
- **Collaborative learning:** Encourage group interactions with chatbots to foster collaboration and teamwork, and offer shared learning experiences.
- **Maintenance:** Regularly update chatbot content to maintain relevance and interest.

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Indicative related resources

Boiano, S., Borda, A., Gaia, G., et al. Chatbots and New Audience Opportunities for Museums and Heritage Organisations. *Electronic Visualisation and the Arts (EVA)*, 9-13 July 2018.

Boiano, S., Gaia, G. (2017) 5 Tips for Involving Teenagers in Your Museum Using a Chatbot, 27 June 2017.

Noh, Y. G., Hong, J. H. (2021). Designing Reenacted Chatbots to Enhance Museum Experience. *Applied Sciences*, 11, 7420.

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2. Digital tools to enhance contextual or multimedia information of pieces of art

2.1. QR-codes

How QR-codes can contribute to health and wellbeing promotion

- QR codes facilitate easy access to information, allowing visitors to engage with exhibits without physical strain.
- They promote mobility and exploration within the museum space by providing contextual information at the visitor's convenience.
- They develop digital competencies, empowering visitors to navigate and interact with digital content independently.
- They offer satisfaction by enabling visitors to access comprehensive information about exhibits, enhancing their understanding and appreciation.
- They foster self-esteem, and motivation through personalized learning experiences.
- They foster emotional engagement by stimulating curiosity and interest in exhibits, encouraging participation and discussion among visitors.
- They support active citizenship by providing opportunities for visitors to engage with cultural content and share their experiences with others, fostering a sense of community.

Guidelines

- **Integration:** Use QR codes alongside traditional displays to enhance engagement and learning.
- **Design:** Ensure QR codes are aesthetically integrated and accessible at various levels to encourage interaction.
- **Accessibility:** Use QR codes like NaviLens for visually impaired visitors, ensuring inclusivity.
- **Self-directed learning:** Encourage visitors to explore additional content and deepen their understanding at their own pace.
- **Emotional mapping:** Combine QR codes with other technologies to create immersive learning environments.
- **Interactive experiences:** Design QR codes that provide interactive and multimedia content to stimulate curiosity and engagement.

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Indicative related resources

Ali, S., Koleva, B., Bedwell, B., Benford, S. (2018). Deepening Visitor Engagement with Museum Exhibits through Hand-crafted Visual Markers. *Proceedings of the 2018 Designing Interactive Systems Conference* (DIS '18). Association for Computing Machinery, New York, NY, USA, 523–534.

Guazzaroni, G. (2013). Emotional mapping of the archaeologist game. *Computers in Human Behavior*, 29(2), pp. 335-344.

Mogali, S. R., Vallabhajosyula, R., Ng, C. H., Lim, D., Ang, E. T., Abrahams, P. (2019). Scan and Learn: Quick Response Code Enabled Museum for Mobile Learning of Anatomy and Pathology. *Anatomical sciences education*, 12(6), pp. 664–672.

Pérez-Sanagustín, M., Parra, D., Verdugo, R., García-Galleguillos, G., Nussbaum, M. (2016) Using QR codes to increase user engagement in museum-like spaces. *Computers in Human Behavior*, Volume 60, pp. 73-85, ISSN 0747-5632.

De Miquel Santed, L., Baeza Albaladejo, R., & Fernández Azorín, T. (2022, January). Nuevo lenguaje, nuevas herramientas, nuevas experiencias: la visita virtual y las etiquetas Navilens en el Museo Arqueológico de Murcia. In CIMED 21-I Congreso internacional de museos y estrategias digitales (pp. 421-435). Editorial Universitat Politècnica de València.

2.2. NFC tags

How NFC tags can contribute to health and wellbeing promotion

- NFC tags provide seamless access to (multimedia) information without the need for physical interaction with exhibits, reducing physical strain for visitors.
- They enhance satisfaction and emotional engagement by offering immersive experiences and in-depth knowledge, fostering a deeper connection with the exhibits and enriching visitors' overall museum experience.
- They support communal learning experiences and broaden access to museum content.

Guidelines

- **Integration:** Use NFC tags to provide multimedia information, enhancing visitor learning and experience.
- **Usability:** Ensure the NFC interface is user-friendly and accessible to all visitors.
- **Data utilization:** Collect and analyze visitor interaction data to improve exhibits and personalize experiences.
- **Augmented context:** Provide rich educational content through NFC tags, making exhibits more informative.

- **Interactive learning:** Use NFC technology to create dynamic and interactive learning paths tailored to visitor preferences.
- **Remote access:** Extend museum experiences beyond physical visits by allowing remote access to NFC-triggered content.

Indicative related resources

Bihler, P., Imhoff, P., Cremers, A. B. (2011). SmartGuide – A Smartphone Museum Guide with Ultrasound Control. *The 8th International Conference on Mobile Web Information Systems (MobiWIS).*

Rudametkin, W., Touseau, L., Perisanidi, M., Gomez, A., Donsez, D. NFCMuseum: an Open-Source Middleware for Augmenting Museum Exhibits.

Setiabudi, D. J., Wiguno, R. C., Palit, H. N. (2017). Near Field Communication Technology in Delivering Information in Museums. *International Conference on Soft Computing, Intelligent System and Information Technology.*

2.3. Informative or multimedia totems

How informative or multimedia totems can contribute to health and wellbeing promotion

- Informative or multimedia totems offer interactive experiences that cater to different learning styles, accommodating visitors with diverse interests and abilities.
- They contribute to satisfaction by personalizing museum experiences, allowing visitors to engage with exhibits in ways that resonate with their learning needs and preferences.
- They encourage group participation and discussions, fostering a collaborative learning environment.
- They promote emotional engagement, creating a sense of community and shared learning.

Guidelines

- **Placement:** Place totems strategically to provide accessible information throughout the museum.
- **Content:** Use interactive and engaging content to attract different age groups and learning styles.
- **Adaptability:** Ensure totems can be easily updated with new content to keep the experience fresh and relevant.
- **Personalized paths:** Use totems to suggest personalized paths within the museum based on visitor profiles and preferences.

- **Interactive feedback:** Incorporate facial coding and other technologies to gauge visitor reactions and adapt content in real-time.
- **AR integration:** Enhance exhibits with augmented reality to provide deeper, more immersive learning experiences.

Indicative related resources

Altieri, A., Ceccacci, S., Giraldi, L., Leopardi, A., Mengoni, M., Talipu, A. (2021). Affective Guide for Museum: A System to Suggest Museum Paths Based on Visitors' Emotions. In M. Antona & C. Stephanidis. (Eds.), *Universal Access in Human-Computer Interaction. Design Methods and User Experience.* HCII 2021. Lecture Notes in Computer Science, 12768. Springer: Cham.

Cirafici, A., Maniello, D., Amoretti, V. (2015). The magnificent adventure of a "fragment". Block NXLVI parthenon north frieze in augmented reality. *SCIRES-IT,* 5(2), pp. 129-142.

Concone, F., Giaconia, R., Re, G.L., & Morana, M. (2021). A Smart Assistant for Visual Recognition of Painted Scenes. *IUI Workshops 2021.*

2.4. Augmented Reality (AR)

How Augmented Reality (AR) can contribute to health and wellbeing promotion

- AR enhances accessibility by providing virtual experiences that enable visitors to interact with exhibits regardless of physical limitations.
- AR boosts curiosity, satisfaction and a sense of accomplishment by offering immersive and interactive learning experiences, captivating visitors' attention and enhancing their enjoyment of exhibits.
- AR fosters emotional engagement by encouraging collaboration and shared experiences among visitors, fostering connections and meaningful interactions.

Guidelines

- **Integration:** Integrate AR applications with existing exhibits to enhance the discovery-based learning process.
- **Accessibility:** Ensure AR applications are user-friendly and accessible to visitors of all ages and digital competences.
- **Engagement:** Use AR to highlight and contextualize exhibits, making them more engaging and informative.
- **Experiential learning:** Use AR to create interactive and immersive experiences that support various learning styles and needs.
- **Knowledge enhancement:** Develop AR content that complements and extends the information available in the physical exhibits.

- **Motivation:** Use storytelling and gamification elements within AR to motivate and sustain visitor interest and engagement.

Indicative related resources

Ghouaiel, N., Garbaya, S., Cieutat, J.-M., & Jessel, J.-P. (2017). Mobile Augmented Reality in Museums: Towards Enhancing Visitor's Learning Experience. *International Journal of Virtual Reality*, 17(1), pp. 21–31.

Moorhouse, N., Dieck, T., Jung, T. (2019) An experiential view to children learning in museums with Augmented Reality. *Museum Management and Curatorship*, 34(4), pp. 402-418.

2.5. Blockchain technology (NFTs)

How blockchain technology (NFTs) can contribute to health and wellbeing promotion

- Blockchain applications can be accessed digitally, minimizing physical effort.
- Blockchain fosters satisfaction by empowering visitors to contribute to the creation and preservation of cultural heritage, increasing their sense of ownership and value.
- Blockchain promotes active citizenship by facilitating transparent and inclusive practices in museums, fostering collaboration and community engagement around cultural preservation and knowledge dissemination.
- Blockchain technology ensures data integrity and security, safeguarding visitors' personal information and enhancing trust in museum operations.

Guidelines

- **Implementation:** Explore the use of blockchain for digital rights management, security, and visitor engagement through NFTs.
- **Collaboration:** Use blockchain to facilitate the exchange of collections and collaboration between museums, enriching the visitors' experiences.
- **Innovation:** Experiment with blockchain to add layers of interpretation and value to museum objects.
- **Interactive engagement:** Allow visitors to contribute to the digital narrative of exhibits, enhancing their personal connection and investment.
- **Digital literacy:** Educate visitors about blockchain technology and its applications in art and museum contexts.

- **Crowdsourcing knowledge:** Use blockchain to enable visitors to co-create and share their insights, enriching the collective knowledge base.

Indicative related resources

Liddel, F. (2021). Building Shared Guardianship through Blockchain Technology and Digital Museum Objects. *Museum & Society*, 19(2).

Siountri, K., Skondras, E., Vergados, D. D. (2019). Towards a Smart Museum using BIM, IoT, Blockchain and Advanced Digital Technologies. *Proceedings of the 3rd International Conference on Vision, Image and Signal Processing (ICVISP 2019)*. Association for Computing Machinery, New York, NY, USA, Article 23, pp. 1–6.

Zhao, L., Zhang, J., Jing, H., Wu, J., Huang, Y. (2022). A Blockchain-Based Cryptographic Interaction Method of Digital Museum Collections. *Journal of Cultural Heritage,* 59 (January–February 2023). pp. 69-82.

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3. Digital tools to contextualize simulations of real pieces of art

3.1. Virtual Reality (VR)

How Virtual Reality (VR) can contribute to health and wellbeing promotion

- VR enables visitors to engage with exhibits remotely, reducing physical strain and providing access to museum artifacts not physically on display.
- VR offers immersive experiences that enhance satisfaction, motivation and learning by providing in-depth understanding and meaningful interactions with cultural heritage.
- VR fosters emotional engagement by facilitating shared experiences among visitors, promoting dialogue, and connection with museum content.
- Shared VR experiences can foster social interaction and collaborative learning among visitors.

Guidelines

- **Integration:** Integrate VR experiences into traditional museum exhibits to enhance understanding and engagement.
- **User-friendly design:** Develop intuitive and accessible VR interfaces to accommodate a broad range of visitors.
- **Content variety:** Create diverse VR experiences that cater to different interests and learning styles.
- **Immersive learning:** Use VR to create deep, immersive experiences that allow visitors to explore historical contexts and artworks in a detailed manner.
- **Interdisciplinary collaboration:** Involve experts from various fields to design authentic and informative VR content.
- **Visitor feedback:** Continuously gather and analyze visitor feedback to refine and improve VR experiences.

Indicative related resources

Gatto, C., D'Errico, G., Paladini, G.I., De Paolis, L.T. (2021). Virtual Reality in Italian Museums: A Brief Discussion. L. T. De Paolis, P. Arpaia & P. Bourdot. (Eds.), *Augmented Reality, Virtual Reality, and Computer Graphics. AVR 2021. Lecture Notes in Computer Science*, 12980. Springer: Cham.

Gobira, P., de Oliveria Silva, E. (2019). About reality: Relations between museums and virtual reality. *Virtual Creativity,* 9(1-2), pp. 63-72

Lowry, E., Jackson, N., Herchenroder L., Guy L. (2019). *Archiving a museum with an interactive exhibit. A report to detail the process of creating an interactive, virtual reality exhibit for the Hönnunarsafn Íslands Museum of Design and Applied Art*. October 8, 2019.

Lee, H., Hyungsoo Jung, T., tom Dieck, M.C., Chung, N. (2020). Experiencing immersive virtual reality in museums. *Information & Management*, 57(5).

Schofield, G. P., Beale, G., Beale, N. E. (2018). Viking VR: Designing a Virtual Reality Experience for a Museum. *DIS 2018 - Proceedings of the 2018 Designing Interactive Systems Conference. ACM DIS Conference on Designing Interactive Systems*, 09-13 Jun 2018 ACM, HKG, pp. 805-816.

3.2. Wall projectors

How wall projectors can contribute to health and wellbeing promotion

- Wall projectors provide integrated guidance systems that enhance visitor understanding without the need for physical interaction with exhibits.
- Projected images and descriptions highlight hidden details, increasing motivation, satisfaction and engagement with exhibited materials.
- Wall projectors encourage connection and emotional engagement by facilitating real-time interactions, group participation and discussion among visitors.

Guidelines

- **Strategic placement:** Position projectors to maximize visibility and engagement without causing distractions.
- **Content sensitivity:** Avoid projecting sensitive content in areas where visitors might walk over it to ensure comfort.
- **Real-time interaction:** Ensure interactive projections provide immediate feedback to enhance visitor engagement.
- **Augmented displays:** Use projectors to highlight and explain details of exhibits, enhancing visual and cognitive understanding.
- **Integrated guidance:** Develop projection systems that provide integrated guidance and contextual information to minimize distractions.
- **Visitor interaction:** Encourage visitor interaction with projections to create a more engaging and participatory experience.

Indicative related resources

Miyata, K., Takiguchi, T., Nakaguchi, T., Tsumura, N., Miyake, Y. (2008). An application of projection imaging systems for museum exhibitions. *Proc. SPIE 6807, Color Imaging XIII: Processing, Hardcopy, and Applications*, 68070L.

Schettino, S. (2016) Successful Strategies for Dealing With New Technology in Museums: A Case Study of Immersive Technology at the Immigration Museum, Melbourne. *Museum International*, 68:1-2, pp. 130-135.

Schmidt, S., Steinicke, F. (2017). A Projection-Based Augmented Reality Setup for Blended Museum Experiences. *ICAT-EGVE*, pp. 1–2.

3.3. 3D holographic projections

How 3D holographic projections can contribute to health and wellbeing promotion

- 3D holographic projections offer interactive and engaging experiences, making artworks accessible to wider audiences.
- They foster emotional engagement by sparking curiosity, desire to learn, and interest in cultural objects.
- Shared exploration of cultural heritage with holograms, promotes collaboration and communication among visitors, enhancing social connections.

Guidelines

- **Multi-channel interaction:** Develop holographic systems that support visual, motion, and verbal interactions to cater to diverse visitor profiles.
- **Realistic representation:** Ensure holographic projections accurately represent real artifacts to provide an authentic experience.
- **Contextual information:** Include comprehensive contextual information in holographic displays to enhance learning.
- **Interactive exploration:** Allow visitors to manipulate and interact with 3D holographic representations to deepen their understanding.
- **Natural language interaction:** Incorporate AI-powered dialogue systems to facilitate natural and informative conversations with visitors.
- **Visitor demographics:** Tailor holographic content to different age groups and interests to ensure broad appeal.

Indicative related resources

Caggianese, G., De Pietro, G., Esposito, M., Gallo, L., Minutolo, A., Neroni, P. (2020). Discovering Leonardo with artificial intelligence and holograms: A user study. *Pattern Recognition Letters*, 131, pp. 361-367.

Chessa, M., Garibotti, M., Rossi, V., Novellino, A., Solari, F. (2015). A virtual holographic display case for museum installations. *7th International Conference on Intelligent Technologies for Interactive Entertainment* (INTETAIN), 2015, pp. 69-73.

White Paper: Feasibility of using Holographic or Holographic-like technology in Museum Exhibits.

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3.4. 3D Printings

How 3D Printings can contribute to health and wellbeing promotion

- 3D printed replicas provide tactile experiences, enhancing accessibility and offering a more meaningful interaction with museum exhibits.
- 3D printings promote psychological wellbeing by fostering inclusion, accessibility, and a sense of accomplishment through hands-on activities.
- Collaborative 3D printing activities encourage teamwork, social interaction and community building, creating a supportive and engaging learning environment.

Guidelines

- **Technology integration:** Use 3D printing in conjunction with other digital tools to provide a comprehensive learning experience.
- **Validation process:** Ensure 3D printed models are accurate and validated to maintain the integrity of the artifacts.
- **Accessibility:** Use 3D printing to create tactile replicas of artifacts for visually impaired visitors, and hands-on learning experiences.
- **Educational workshops and hands-on activities:** Organize workshops where visitors can learn about 3D printing technology and create replicas, cultivating their digital skills, while fostering their cultural understanding and awareness.
- **Collaborative projects:** Encourage group projects where visitors can collaborate on 3D printing tasks, fostering teamwork and creativity.

Indicative related resources

Ballarin, M., Balletti, C., and Vernier, P. (2018). Replicas in cultural heritage: 3D printing and the museum experience. *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLII-2, 55–62.

Hancock, M. (2016). Museums and 3D Printing: More Than a Workshop Novelty, Connecting to Collections and the Classroom. *Bulletin of the Association for Information Science and Technology*, 42(1), pp. 32-35.

Hess, M., & Robson, S. (2013). Re-engineering Watt: A case study and best practice recommendations for 3D colour laser scans and 3D printing in museum artefact documentation. Conference: Lasers in the Conservation of Artworks IX.

Wilson, P.F., Stott,Jason, J., Warnett, M., Attridge, A., Smith, M. P., Williams, M. A. (2018). Evaluation of Touchable 3D-Printed Replicas. *Museums. Curator. The Museum Journal*, 60(4), pp. 445-465.

Wilson, P. F., Stott, J., Warnett, J. M., Attridge, A., Smith, M. P., & Williams, M. A. (2018). Museum visitor preference for the physical properties of 3D printed replicas. *Journal of Cultural Heritage*, 32(Complete), 176–185.

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3.5. Video mapping

How video mapping can contribute to health and wellbeing promotion

- Video mapping enhances the visual experience of museum sites, providing engaging and accessible interactions without physical strain.
- Immersive video mapping installations promote satisfaction and interest in cultural heritage, offering captivating and enjoyable experiences for visitors.
- Video mapping encourages interaction and discussion among visitors, fostering a sense of community and shared exploration of museum spaces.

Guidelines

- **Site-specific design:** Customize video mapping installations to enhance specific features of the museum's architecture and exhibits.
- **Content relevance:** Ensure projected content is relevant and enhances the understanding of the exhibits without overshadowing them.
- **Collaborative interaction:** Design video mapping experiences that encourage visitor interaction and collaboration.
- **Augmented Reality:** Use video mapping to create augmented reality experiences that provide additional context to physical exhibits.
- **Role-playing:** Encourage visitors to take on different roles within the video mapping experience to foster engagement and understanding.
- **Interactive control:** Allow visitors to control certain aspects of the video mapping installation to enhance their sense of involvement.

Indicative related resources

Nofal, E., Stevens, R., Coomans, T., Vande Moere, A. (2018). Communicating the Spatiotemporal Transformation of Architectural Heritage via an In-Situ Projection Mapping Installation. *Digital Applications in Archaeology and Cultural Heritage*.

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4. Digital methodologies to enhance learning processes

4.1. Digital Storytelling

How digital storytelling can contribute to health and wellbeing promotion

- Digital storytelling offers a non-physical, yet engaging way to interact with cultural heritage, reducing physical strain, and providing accessibility to diverse audiences.
- Digital storytelling promotes inclusion and accessibility by making cultural content culturally accessible and emotionally engaging.
- By fostering emotional engagement, digital storytelling promotes a sense of cultural belonging, encouraging dialogue, interaction, and connection among visitors.

Guidelines

- **User-friendly platforms:** Use platforms like narrative storyboard editors and narrative mobile players to facilitate the creation and delivery of digital stories.
- **Personalization:** Implement systems like CHESS (Cultural Heritage Experiences through Socio-personal interactions and Storytelling) to offer personalized interactive stories tailored to individual visitor preferences.
- **Emotional engagement:** Focus on creating content that stimulates emotional connections, making the content culturally accessible and memorable, and the museum experience more relatable and immersive.
- **Skill development:** Enhance digital competencies and transversal skills through the co-creation of digital stories with the participation of visitors.
- **Feedback loop:** Collect and analyse visitor and curator feedback to continuously improve the storytelling experience.

Indicative related resources

Katifori, A. et al. (2014). CHESS: Personalized Storytelling Experiences in Museums. In A. Mitchell, C. Fernández-Vara, D. Thue. (Eds.), *Interactive Storytelling*. ICIDS 2014. Lecture Notes in Computer Science, 8832. Springer: Cham.

Pujol, L., Roussou, M., Poulo, S., Balet, O., Vayanou, M. and Ioannidis, Y. (2012). Personalising Interactive Digital Storytelling in Archaeological Museums: The CHESS Project, *40th Annual Conference of Computer Applications and Quantitative Methods in Archaeology* (CAA), Southampton, UK, 26-29 March 2012, pp. 77-90.

Robin, B. R. (2016). The Power of Digital Storytelling to Support Teaching and Learning. *Digital Education Review*. 30.

Vrettakis, E., Kourtis, V., Katifori, A., Karvounis, M., Lougiakis, C., Ioannidis, Y. (2019). Narralive – Creating and experiencing mobile digital storytelling in cultural heritage. *Digital Applications in Archaeology and Cultural Heritage,* 15.

4.2. Hands-on exhibits (tactile reproductions)

How hands-on exhibits (tactile reproductions) can contribute to health and wellbeing promotion

- Hands-on exhibits (tactile reproductions) ensure accessibility and inclusivity, providing tactile experiences that engage visitors actively.
- They promote psychological well-being by fostering interest, motivation, and a desire to learn through interactive experiences.
- They encourage communication, interaction and critical thinking, creating a supportive, engaging and shared learning environment for all visitors.

Guidelines

- **Partially completed exhibits:** Design exhibits that are partially completed to encourage engagement and motivation among visitors.
- **Guidance:** Train museum staff members on effective coaching styles to enhance visitors' exploratory behavior and learning.
- **Tinkering programs:** Develop tinkering programs that support engineering learning and encourage testing and redesign.
- **Exploratory learning:** Encourage hands-on activities that promote exploration and tactile learning.
- **Interaction:** Facilitate interactions where museum educators guide visitors through hands-on activities, enhancing learning outcomes, creativity and active participation.
- **Iterative design:** Use design-based research methods to continuously refine hands-on exhibits and programs based on visitor interaction data.

Indicative related resources

Scaradozzi, D., Guasti, L., Di Stasio, M., Miotti, D., Monteriù, A., Blikstein, P. (2021). *Makers at School, Educational Robotics and Innovative Learning Environments: Research and Experiences from FabLearn Italy 2019, in the Italian Schools and Beyond*. Svizzera: Springer International Publishing.

Caulton, T. (2006). *Hands-On Exhibitions: Managing Interactive Museums and Science Centres*. Regno Unito: Taylor & Francis.

Paris, S. (1996). Children's Motivation to Explore Partially Completed Exhibits in Hands-On Museums. *Contemporary Educational Psychology*, 21, pp. 111-128.

Pagano, L. C., Haden, C. A., Uttal, D. H. (2020). Museum program design supports parent-child engineering talk during tinkering and reminiscing. *Journal of Experimental Child Psychology*.

Van Schijndel, T. J. P., Franse, R. K., Raijmakers, M. J. E. (2010). The Exploratory Behavior Scale: Assessing young visitors' hands-on behavior in science museums. *Science Education,* 94(5), pp. 794-809.

4.3. Gamification

How gamification can contribute to health and wellbeing promotion

- Gamification enhances the museum experience by providing interactive and engaging activities for visitors.
- Gamification increases motivation and satisfaction by activating emotions and curiosity, offering clear learning objectives, while making learning more enjoyable and effective.
- By encouraging participation, gamification fosters collaboration, interaction, and shared exploration among visitors.
- Gamified AR paths and mobile experiences reduce the need for physical movement, accommodating visitors with varying physical capabilities.

Guidelines

- **Game elements:** Integrate game elements such as quests, achievements, and levels to make the museum experience more engaging and educational.
- **Motivational design:** Create gamified experiences that motivate visitors through challenges and rewards, enhancing their engagement and learning.
- **Structured learning:** Use gamification to provide a clear vision of learning objectives, making visits more purposeful.
- **Emotional activation:** Design game elements that activate emotions and curiosity, driving deeper learning and retention.
- **Crowd control:** Use gamified AR paths to guide visitor flow, reducing physical strain and listener fatigue.
- **Cost-effective solutions:** Develop gamified experiences that can be accessed on smartphones and tablets to reduce hardware costs.

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Indicative related resources

Bieszk-Stolorz, B., Dmytrów, K., Eglinskiene, J., Marx, S., Miluniec, A., Muszyńska, K., Niedoszytko, G., Podlesińska, W., Rostoványi, A. V., Swacha, J., Vilsholm, R. L., Vurzer, S. (2021). Impact of the availability of gamified e-guides on museum visit intention. *Procedia Computer Science*, 192, pp. 4358-4366.

Lee, C.I. (2022). Benefit Analysis of Gamified Augmented Reality Navigation System. *Appl. Sci.*, 12, 2969.

Paliokas, I., Patenidis, A. T., Mitsopoulou, E. E., Tsita, C., Pehlivanides, G., Karyati, E., Tsafaras, S., et al. (2020). A Gamified Augmented Reality Application for Digital Heritage and Tourism. *Applied Sciences*, 10(21), 7868. MDPI AG.

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5. Sensory-based Technologies

5.1. Heighten-sensory-awareness technologies

How heighten-sensory-awareness technologies can contribute to health and wellbeing promotion

- Engaging physical movements through interactive installations can provide light physical activity, promoting overall health.
- Interactive and immersive experiences can enhance satisfaction and enjoyment, reducing stress and promoting mental health.
- Collaborative installations foster social interaction and community building among visitors.

Guidelines

- **Interactive installations:** Use Kinect motion-sensing controllers, projectors, and projection mapping software to create interactive environments where visitors can engage through movement and touch.
- **Collaborative spaces:** Design installations that encourage interaction between visitors to foster communication and collaboration.
- **Active participation:** Enable visitors to actively participate by interacting with projected images and videos, enhancing their engagement and learning experience.

Indicative related resources

Schmidt, S., Steinicke, F., Irlitti, A., Thomas, B. H. (2018). Floor-Projected Guidance Cues for Collaborative Exploration of Spatial Augmented Reality Setups. *Proceedings of the 2018 ACM International Conference on Interactive Surfaces and Spaces (ISS '18)*. Association for Computing Machinery, New York, NY, USA, pp. 279–289.

5.2. Gesture-based technology

How gesture-based technology can contribute to health and wellbeing promotion

- Gesture-based interactions promote movement, contributing to physical activity.
- Engaging and interactive experiences can boost motivation and interest, enhancing overall enjoyment and mental health.
- Interactive and multisensory experiences can stimulate discussion and reflection, fostering social connections.

Guidelines

- **Multisensory engagement:** Integrate gesture-based technologies that allow visitors to control exhibits using body movements, enhancing interactivity.
- **Interactive learning:** Design exhibits that respond to gestures, making the learning process more engaging and dynamic.
- **Educational enhancement:** Use gesture recognition to provide an immersive learning environment that encourages reflection and discussion.
- **Reflective practice:** Encourage visitors to reflect on their experiences and discuss their interactions, enhancing critical thinking and understanding.

Indicative related resources

Hai, H., Lo, W. H., Ng, H. H., Brailsford, T., & O'Malley, C. (2018). Enhancing reflective learning experiences in museums through interactive installations. *13th International Conference of the Learning Sciences (ICLS) 2018*, pp. 776-783.

Tokuoka, M., Mizoguchi, Egusa, R., Inagaki, S., Kusunoki, F. (2018). Effectiveness of a Cooperative Museum Learning Support System based on Multiple People Body Movements. *International Journal of Education and Research*, 6(11), pp. 197-208.

5.3. Haptics

How haptics can contribute to health and wellbeing promotion

- Engaging in tactile activities can provide sensory stimulation, beneficial for visitors with sensory processing needs.
- Haptic experiences can enhance emotional engagement, making the experience more satisfying and enjoyable.
- Shared tactile experiences can foster empathy and social bonding among visitors.

Guidelines

- **Tactile interaction:** Incorporate haptic technology to provide tactile activities, allowing visitors to physically interact with digital replicas of museum objects.
- **Enhanced engagement:** Use haptic devices to create a more immersive and engaging experience, making the museum visit more memorable.
- **Tactile learning:** Enable visitors to feel the textures and shapes of objects, enhancing their understanding and connection to the exhibits.
- **Multisensory experience:** Combine visual and haptic cues to provide a richer, more comprehensive sensory experience.

Indicative related resources

Butler, M., Neave, P. (2008). Object appreciation through haptic interaction. In R. Atkinson, & C. McBeath (Eds.), *Proceedings of the 25th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education* (ascilite Melbourne 2008). Deakin University, pp. 133-141.

Dima, M., Hurcombe, L., Wright, M. (2014). Touching the Past: Haptic Augmented Reality for Museum Artefacts. In R. Shumaker, S. Lackey (Eds.), Virtual, Augmented and Mixed Reality. *Applications of Virtual and Augmented Reality. VAMR 2014. Lecture Notes in Computer Science*, 8526. Springer, Cham.

Vi, C. T., Ablart, D., Gatti, E., Velasco, C., Obrist, M. (2017). Not just seeing, but also feeling art: Mid-air haptic experiences integrated in a multisensory art exhibition. *International Journal of Human-Computer Studies*, 108, pp. 1-14.

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5.4. Smell artifacts

How smell artifacts can contribute to health and wellbeing promotion

- While olfactory engagement is primarily sensory, it can provide mental relaxation and stress relief.
- Scents can trigger positive emotions and memories, enhancing overall well-being and satisfaction.
- Shared olfactory experiences can create a sense of shared memory and community among visitors.

Guidelines

- **Olfactory integration:** Use smell to complement visual and auditory stimuli, creating a multisensory experience that engages visitors on a deeper level.
- **Emotional connection:** Select scents that evoke strong emotional responses and memories to make the learning experience more personal and impactful.
- **Multisensory learning:** Combine olfactory stimuli with visual and auditory elements to create a comprehensive learning environment.

Indicative related resources

Levent, N. & Pascual-Leone, A. (Ed.) (2014). *The Multisensory Museum Cross-Disciplinary Perspectives on Touch, Sound, Smell, Memory, and Space.* Lanham: Rowman & Littlefield.

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6. Technologies for studying visitors' emotions and preferences

6.1. AI for identifying visitors' behaviours and preferences

How A.I. for identifying visitors' behaviours and preferences can contribute to health and wellbeing promotion

- By analyzing visitor behaviors and preferences, AI can personalize museum content, fostering emotional engagement and interest, and enhancing the visitor experiences.
- AI can support psychological well-being by tailoring museum experiences to individual preferences, promoting satisfaction and self-esteem.
- AI can foster inclusive environments and enhance a sense of community by addressing diverse visitor needs.

Guidelines

- **Personalization:** Utilize AI to personalize museum content based on visitor interactions and preferences to enhance engagement.
- **Multimodal data collection:** Implement sensors to collect data on eye gaze, facial expressions, posture, and interaction logs.
- **Predictive engagement models:** Use machine learning techniques to predict visitor engagement and adjust exhibits in real-time.
- **Visitor personas:** Develop visitor personas based on their motivations and behaviors to tailor experiences.

Indicative related resources

Almeshari, M., Dowell, J., Nyhan, J. (2021). Museum Mobile Guide Preferences of Different Visitor Personas. *J. Comput. Cult. Herit.* 14, 1, Article 9 (February 2021).

Almeshari, M., Dowell, J., Nyhan, J. (2019). Using Personas to Model Museum Visitors. *Adjunct Publication of the 27th Conference on User Modeling, Adaptation and Personalization* (UMAP 19 Adjunct). Association for Computing Machinery, New York, NY, USA, 401–405.

Emerson, A., Henderson, N., Rowe, J., Min, W., Lee, S., Minogue, J., Lester, J. (2020). Early Prediction of Visitor Engagement in Science Museums with Multimodal Learning Analytics. *Proceedings of the 2020 International Conference on Multimodal Interaction* (ICMI '20). Association for Computing Machinery, New York, NY, USA, 107–116.

Trejo, K., Angulo, C., Satoh, S. Bono, M. (2018). Towards robots reasoning about group behavior of museum visitors: Leader detection and group tracking. *Journal of Ambient Intelligence and Smart Environments*, 10(1), pp. 3-19, 2018.

Zancanaro, M., Kuflik, T., Boger, Z., Goren-Bar, D., Goldwasser, D. (2007). Analyzing Museum Visitors' Behavior Patterns. In Conati, C., McCoy, K., Paliouras, G. (Eds.), *User Modeling* 2007. UM 2007. Lecture Notes in Computer Science, 4511. Springer, Berlin, Heidelberg.

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6.2. Software Mezzini

How software Mezzini can contribute to health and wellbeing promotion

- Software Mezzini assists visitors during museum visits without physical strain, by optimizing exhibit layouts to encourage smooth and comfortable navigation.
- By providing personalized recommendations and content, Software Mezzini increases visitor engagement, satisfaction and engagement, and fosters curiosity and desire to learn.

Guidelines

- **Indoor tracking:** Employ low-cost indoor tracking systems using RGB cameras and badges to monitor visitor behavior.
- **Personalized recommendations:** Offer personalized content and recommendations based on visitor behavior.
- **Behavior analysis:** Analyze individual and social behavior to improve exhibit arrangements and visitor flow.
- **Data-driven adjustments:** Continuously adjust exhibits based on real-time data to optimize visitor experience.

Indicative related resources

Cepeda-Pacheco, J.C., Domingo, M.C. (2022). Deep learning and Internet of Things for tourist attraction recommendations in smart cities. *Neural Computing and Applications,* 34, pp. 7691–7709.

Ferrato, A., Limongelli, C., Mezzini, M., & Sansonetti, G. (2022). Using Deep Learning for Collecting Data about Museum Visitor Behavior. *Applied Sciences*, 12(2), 533. MDPI AG.

6.3. Eye-tracking for mapping emotional responses during museum visits

How eye-tracking for mapping emotional responses during museum visits can contribute to health and wellbeing promotion

- Eye-tracking technology maps emotional responses, providing insights into visitor engagement and satisfaction.
- By understanding visitors' emotional responses, eye-tracking can help create more engaging exhibits that encourage movement, exploration, engagement and curiosity.
- Eye-tracking can also help enhance satisfaction by aligning exhibit design with visitor interests and emotional responses.
- It can also promote shared experiences and discussions based on common points of interest identified through eye-tracking.

Guidelines

- **Visual attention analysis:** Use eye-tracking to understand how visitors interact with exhibits and what captures their attention.
- **Emotional mapping:** Combine eye-tracking with surveys to map emotional responses and improve exhibit design.
- **Interactive displays:** Design explanations and descriptions based on eye-tracking data to enhance engagement.
- **Augmented Reality (AR):** Use AR to superimpose information based on where visitors are looking, enhancing emotional engagement.

Indicative related resources

Krogh-Jespersen, S., Quinn, K.A., Krenzer, W.L.D., Nguyen, C., Greenslit, J., Price, C.A. (2020). Exploring the awe-some: Mobile eye-tracking insights into awe in a science museum. *PLoS ONE* 15(9).

Rainoldi, M., Yu, CE., Neuhofer, B. (2020). The Museum Learning Experience Through the Visitors' Eyes: An eye-tracking Exploration of the Physical Context. Rainoldi, M., Jooss, M. (Eds.), *Tourism on the Verge. Eye Tracking in Tourism*. Springer: Cham.

6.4. Smartwatch for mapping emotional responses during museum visits

How smartwatch for mapping emotional responses during museum visits can contribute to health and wellbeing promotion

- Smartwatch-based systems can help facilitate museum exploration without physical strain, by mapping emotional responses to enhance the visitor experience.
- By detecting emotions and satisfaction levels, smartwatch technologies can support psychological well-being and foster interest and vitality.

Guidelines

- **Emotional detection:** Use smartwatches to monitor visitors' heart rates and map emotional responses throughout their visit.
- **Interactive guidance:** Provide real-time feedback and guidance based on emotional responses.
- **Journey mapping:** Track visitor emotions across different phases of the visit (prospective, active, reflective) to enhance the overall experience.
- **Data integration:** Combine smartwatch data with other visitor feedback to tailor exhibits and improve engagement.

Indicative related resources

Banerjee, A., Robert, R., Horn, M. S. (2018). FieldGuide: Smartwatches in a Multi-display Museum Environment. *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems* (CHI EA '18). Association for Computing Machinery, New York, NY, USA, Paper LBW061, 1–6.

Okabe, A., Ohmura, R. (2016). Poster: Towards Creating User's Impression Map with Wearable Sensors. *Proceedings of the 14th Annual International Conference on Mobile Systems, Applications, and Services Companion* (MobiSys '16 Companion). Association for Computing Machinery, New York, NY, USA, 67.

Shen, S., Sotiriadis, M., & Zhang, Y. (2020). The Influence of Smart Technologies on Customer Journey in Tourist Attractions within the Smart Tourism Management Framework. *Sustainability*, 12(10), 4157.

inclusive memory
INCLUSIVE MUSEUMS FOR WELL-BEING AND HEALTH THROUGH THE CREATION OF A NEW SHARED MEMORY

6.5. Making visitors' visual artefacts - selfies

How making visitors' visual artefacts - selfies can contribute to health and wellbeing promotion

- Selfies provide a costless way for visitors to engage with museum exhibits, promoting self-identity and creativity.
- Selfies foster psychological well-being by allowing visitors to co-create value and meaning, promoting self-expression and emotional engagement.
- Sharing selfies on social media platforms democratizes the museum environment, encouraging participation and collaboration among visitors, and creating a sense of community.

Guidelines

- **Encouraging selfies:** Create designated selfie spots and encourage visitors to take and share selfies with exhibits.
- **Analyzing social media:** Use computer vision to analyze selfies posted on social media to understand visitor behavior and preferences.
- **Co-creation of value:** Facilitate visitor engagement by allowing them to co-create content and share their experiences online.
- **Emotional connection:** Design exhibits that provoke emotions and encourage visitors to capture and share these moments.

Indicative related resources

Piancatelli, C., Massi, M., & Vocino, A. (2021). #artoninstagram: Engaging with art in the era of the selfie. *International Journal of Market Research*, 63(2), pp. 134–160.

Rhee, B. A., Pianzola, F., Choi, J., Hyung, W., Hwang, J. (2022). Visual content analysis of visitors' engagement with an instagrammable exhibition. *Museum Management and Curatorship*, pp. 1-15.