Virtual Reality as a tool to promote tourism in rehabilitated mines

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Introduction | Virtual reality (VR) is a cutting-edge technology that creates immersive, computer-generated environments, allowing users to experience and interact with these virtual worlds as though they were real. The integration of VR enhances the efficiency of tourism operations, creating opportunities for sustainable development and conservation in eco-friendly destinations (Khan et al., 2024). E-tourism includes VR, artificial intelligence, Internet of Things, social media and mobile applications in tourism (Koliouska and Andreopoulou, 2023). From an investment perspective, VR tools can serve as a crucial marketing asset to attract investors or businesses to rehabilitated areas (Triantafillidou et al., 2023). This paper presents an overview of Greek citizens' perceptions on the positive impact of VR tools in promoting rehabilitated mines in Western Macedonia, Greece. The rehabilitated mines were selected as the study area since the transition towards a greener future of Western Macedonia constitutes one of the Greek sustainability strategies.

Theoretical background | The use of VR tools to promote rehabilitated areas offers a powerful way to showcase transformation and attract both tourists and investors. Rehabilitated areas, such as urban regeneration projects, restored historical sites, or revitalized natural environments, can be presented in a compelling and immersive way through VR technology. VR tools can highlight the before-and-after contrasts of the rehabilitation efforts, emphasizing the positive impact of the project

on the environment, community, or local economy, making the progress visually striking and easily understood. VR tools can be used to give potential visitors an immersive preview of rehabilitated mines, particularly if the site is being transformed into a cultural, historical, or ecological attraction (Talwar et al., 2022). This virtual experience can showcase how an old mine has been reimagined as a place for eco-tourism, hiking, or educational tours, where visitors can learn about the mining industry's heritage and its environmental recovery efforts. This can be particularly useful for attracting tourists to regions that may have once been neglected or underdeveloped but are now emerging as attractive spots for travel, culture, and recreation. Cultural tourism is recognized as a means to support both the tangible and intangible aspects of Indigenous cultural heritage, encompassing languages, stories, songs, art, dance, hunting techniques, rituals, and customs (Ruhanen and Whitford, 2019).

Methodology | This paper provides an overview of the perceptions of the Greek citizens on the positive effects of VR tool for the promotion of the rehabilitated mines in Western Macedonia. A questionnaire was delivered to a sample of 100 participants (both male and female of all ages) in September 2024. The questionnaire consisted of 26 closed questions about demographic data, the impacts of mining activities on the natural environment, the recommendations for mine rehabilitation, the use of new technologies to promote rehabilitated mines. The questionnaire included a short video that presented the recommendations for mine rehabilitation in Western Macedonia: an artificial lakes network, a mining history centre, a science park and a lignite vineyard. The collected data were analyzed using SPSS in order to apply descriptive, correlation and factor analysis. By this way, the activities that Greek residents prefer to do in rehabilitated mines are clarified and suggestions regarding the most efficient VR tool for the promotion of each rehabilitated mine is made.

Findings | According to the results, 52 men and 48 women aged 20-70 participated in the survey. Almost half of them live or have lived in the mining region, while most of the rest have already visited the area. Regarding the educational levels, the majority of the participants hold a master's degree.

Correlation analysis indicated that women and older participants tend to be more aware of the negative effects of mining activities on the environment (e.g. air pollution, noise pollution, visual pollution, ecosystem degradation, soil erosio) than others and surer that

new technologies can boost a destination's reputation. On the other hand, a higher perception of the positive impacts of mining activities on the living standards of the residents (socio-economic impacts) is positively correlated with increased educational level. As for land rehabilitation after mining, it seems that women would like to convert the mine into a recreation area. Furthermore, the older participants tend to believe that rehabilitated mines cannot be transformed into tourism attractions.

Furthermore, factor analysis was applied to reduce the types of activities that participants would prefer to undertake in the rehabilitated mines and to define the most popular indoor and outdoor activities. Two factors were calculated that express the majority of the cases: the factor "cultural activities" describes the willingness of the participants to visit the rehabilitated mines for cultural activities and the factor "recreation activities" describes the desire of the participants to do activities such as recreation, sport activities and walking. The fact that the results of the analysis indicate that participants act as there are two groups of their leisure activities, confirms the suitability of the recommendations. The mining history centre and the science park provide cultural activities, whereas artificial lakes network and lignite vineyards provide recreation activities. In conclusion, most participants believe that VR tools will greatly contribute to the enhancement of the overall tourist experience in the rehabilitated mines. In particular, most participants believe that gamification of the artificial lakes network will attract the next tourism generation, 3D model collection of photos of the mining history centre and the science park on a web platform will upgrade the teaching-learning process, interactive applications regarding the rehabilitated mine will be the most effective VR tool for the enhancement of the overall tourist experience in the lignite vineyards.

Contributions and implications | Undoubtedly, the mining region in Western Macedonia has to adjust to the new digital era and to adopt VR tools to attract more tourists to the rehabilitated mines. The findings can be a supportive tool for policymakers, as they prepare the smart green transition towards a low carbon economy in Western Macedonia. By selecting the most suitable VR tools for each case, policymakers will be able to address many social and economic transition challenges.

Conclusion | VR tools play a transformative role in promoting rehabilitated mines by offering immersive, engaging, and detailed representations of these restored sites. Apart from shifting the perceptions of the site from an industrial past to a renewed, sustainable

future but also broadens its appeal for all the types of alternative tourism models. By making these areas more accessible and engaging through virtual experiences, VR supports both the economic revitalization and environmental conservation efforts associated with mine rehabilitation. The results show that the mining region in Western Macedonia has to adjust to the new digital era and to adopt VR tools to promote more effectively the rehabilitated mines as a tourist destination.

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