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EVALUATING THE USABILITY AND LEARNING POTENTIAL OF A VIRTUAL MUSEUM TOUR APPLICATION FOR SCHOOLS

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Abstract

Virtual museums can engage people who cannot visit the museum in person in an immersive experience of the museum collection. The museum diverse displays can help people understand and appreciate cultural heritage while improving their overall knowledge, skills and attitudes. Virtual museum tours have become of great importance to schools – especially when the museums are not in close proximity. This paper describes and evaluates the VISITOR virtual museum app, which enables teachers to select artefacts from diverse collections and add them to their own themed museum. VISITOR combines real artefacts and a constructed virtual space and provides end-users with a 'user as creator' mode. Comprehensive evaluation of such virtual museum tours is, however, needed to ensure their usability and learning potential in the school classroom. We employed qualitative usability testing, and a heuristic evaluation scale based on the literature and the VISITOR's particular aspects. The evaluation results showed that users find the application overall usable, but there appears to still be room for improvement in interactivity and learning potential. Our critical recommendations can inform the redesign of the VISITOR application, and also serve as references for consideration by exhibition or educational technology designers in the design and planning of online virtual museum tours and other virtual tour apps for schools.

Keywords: virtual museum tours, museum education, virtual reality.

1 INTRODUCTION

Museums engage people in diverse displays to help them understand and appreciate cultural heritage while improving their cognitive gains, and attitudinal, affective and social outcomes [1]. Museums often have schools as their primary targets, but school visits to museums are not always possible, especially, when the schools are located in remote areas or due to extraordinary circumstances (i.e., a pandemic). VISITOR is a European research collaboration among universities and small organisations, funded by Erasmus+, that aims to develop virtual museum tours for schools. This paper presents the evaluation of an early version of the web-based application VISITOR that scaffolds virtual museum tours for schools.

The VISITOR app enables teachers to create their own themed museums, by selecting artefacts stored in the application's library or uploading their own artefacts. Compared to other virtual tour space environments [2], the VISITOR space does not really exist in reality, but it is rather partially constructed virtually by the end-user. Therefore, VISITOR differs from most virtual tours that represent physical museum spaces; it is a combination of real artefacts and a constructed virtual space. The early VISITOR app design was aligned with results from a survey of teachers in four European countries (Greece, the UK, Belgium, and France) on their needs and expectations of a virtual museum app [3]. For example, teachers' expectations included the provision of artefacts and several options for their use, and support in evaluating the activity.

The VISITOR application is available in three languages (Greek, English and French). Some features include tutorials with instructions (for students and for teachers), museum curators for extra 'tips', a navigation map with labelled museum rooms, space slots for 2D or 3D artefacts, interacting and reading information about an artefact, uploading an artefact (from the library or by using a link), developing or completing a quiz, receiving badges and points which connect to a leader board, unlocking museum doors, and visiting the director's office upon completion.

The app interface can slightly change for teachers and students with the use of the 'editor mode', which allows the former to become museum creators (user as creator) and moderate the museum activity. For instance, teachers can modify the museum by modifying the theme and name for each museum – as seen in Figure 1 – and upload the relevant artefacts to their themed museums – as seen in Figure 2.

Participants have a third-person camera perspective and can navigate their avatars in the museum by using the navigation arrows on their keyboards.
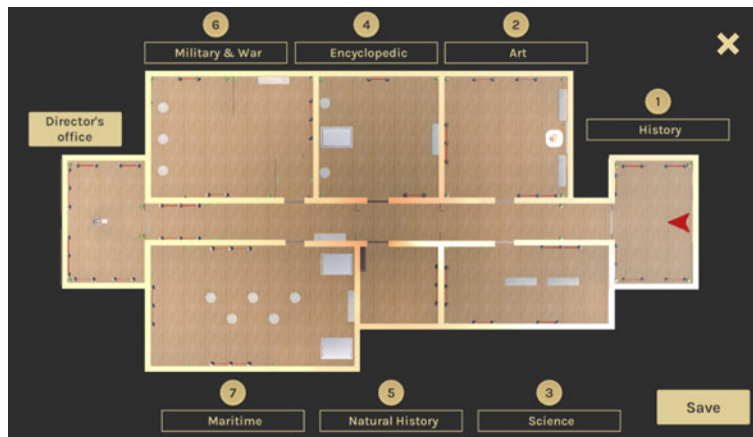

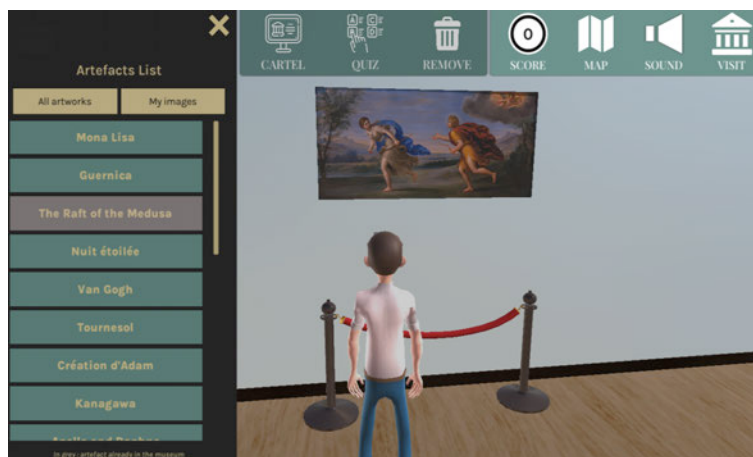*Figure 1. VISITOR app – navigation map with museum rooms.*

Figure 2. VISITOR app - uploading an artefact

Previous work proposes a set of scales for evaluating user experience in virtual museum tours, including several dimensions, such as usability, entertainment, and learning [4]; visual, interaction and experience [5]; and authenticity, interactivity, navigation and learning [6]. However, these scales do not take into account VISITOR's particular feature that allows end-users to modify the virtual space and add their own elements.

This study evaluates the VISITOR app intending to inform its redesign and ensure usability and learning potential. In particular, the purpose of this study is twofold: (a) to evaluate the VISITOR app and suggest improvements and (b) to extend current evaluation methods for online virtual museum tours to capture their learning potential in the school classroom.

2 METHODOLOGY

The evaluation of the virtual museum tour application follows a mixed method iterative design with user testing across many small tests with no more than five users, as this method assures the best evaluation results [7]. The current paper presents the first iteration, which aims to inform the next redesign of the virtual museum tour app. The usability testing involved two phases - qualitative usability testing and a virtual tours evaluation questionnaire.

In Phase A, we ran remote-moderated qualitative usability testing. The core elements of this phase were (a) the facilitator who guided the participant through the test process, (b) the tasks, in the form of two scenarios, with realistic activities that a participant (teacher or student) might actually perform in real life, and (c) the participant, who is the potential user of the virtual museum tour app. The usability testing focused on

discovering problems in the user experience through a concurrent think-aloud protocol, in which the participants were encouraged to verbalise their experience and thoughts while interacting with the app.

The duration of the usability testing was approximately one hour, and the participants engaged in activities that a user would usually engage in: sign in and set up (e.g., you forgot your password! Where will you go to recover it?); navigation and locating museum features (e.g., locate and visit the 'Apollo and Daphne' artefact); interacting with features (e.g., view the information and complete the quiz'); and adding content (e.g., place the 'Van Gogh' painting in one of the museum rooms). Figure 3 shows the specific tasks the student scenario involved, and Figure 4 shows the tasks that were more relevant to the teacher scenario.

Scenario 1 (student)
20 minutes

1. Go to https://visitor-project.eu/game/ and select your language.
2. Register or sign in as a visitor and select your character.
3. Enter museum number 15041.
4. Locate and visit the 'Apollo and Daphne' artefact.
   Hint 1: This is a painting inspired by Greek Mythology.
   Hint 2: you can use the maps function to help you locate the room in which the artefact may be.
5. Once you locate the artefact, view the information and complete the quiz.
6. Locate the other artefact in the room and read the info.
7. View the leaderboard - what is your score?
8. You can now go to the director's office.
9. Sign out - oops, you forgot your password! Where will you go to recover it?

Figure 3. Scenario 1 (student)

Scenario 2 (teacher)
30 minutes

1. Go to https://visitor-project.eu/game/ and select your language.
2. Register or sign in as a creator and select your character.
3. Select 'create/modify my museum' and then 'new visit'.
4. Go to your profile and choose to be a 'creator' in this museum if you are not already.
5. Select the menu and then read the 'tutorial edit mode'
6. Place the 'Van Gogh' painting in one of the museum rooms.
   Hint: the Van Gogh painting is in the artefacts list.
7. Add the following information as appropriate:
   a. Artist: Van Gogh
   b. Creation date: 1889
   c. Artefact Description: *Dutch Post-Impressionist painter Vincent van Gogh painted a self-portrait in oil on canvas in September 1889. The work, which may have been Van Gogh's last self-portrait, was painted shortly before he left Saint-Rémy-de-Provence in southern France. The painting is now at the Musée d'Orsay in Paris.*
8. Add the following question and answers to a quiz.
   a. Question: Which museum is the Van Gogh self-portrait in?
   b. Answers:
      i. Van Gogh Museum (incorrect)
      ii. Musée d'Orsay (correct)
      iii. The Uffizi Gallery (incorrect)
9. Rename the room to be relevant to your artefact, if not already.
10. Sign out.

Figure 4. Scenario 2 (teacher)

In Phase B, the usability testing participants completed a virtual tours evaluation instrument. The questionnaire was an adapted version of Li, Nie and Ye's scale [6], which was inspired by Sutcliffe and Gault's [8] and Kabassi et al.'s [9] scales to the study of virtual tours. The adapted questionnaire used in this study focused on four dimensions of the virtual tours experience, including authenticity (e.g., the artefacts give me a very real feeling), interactivity (e.g., I understand what I can operate and what I can't), navigation (e.g., I know where we start and where we end), and learning potential (e.g., I can assess

gained knowledge on the exhibition via the available features) (Table 1). The statements were slightly modified to evaluate the 'user as creator' aspect and the stronger teaching aspect of the VISITOR app. For instance, the survey respondents can evaluate options for adding material and assessing knowledge.

The participants selected the extent to which they agreed with each of the 19 statements on a scale of 1-5 (where 1 = strongly disagree and 5 = strongly agree). A combination of the findings from the two phases is presented in the results section.

Table 1. Virtual tours evaluation instrument.

Item	Dimension
When I wander, I feel like I'm in a real museum	Authenticity
The artefacts give me a very real feeling	
The space and objects in the virtual exhibit give real responses to my wandering behaviour	
I felt like I was in a real museum	
The process of my virtual tour is very natural, and there are no restrictions	Interactivity
When I move the camera, the picture changes very naturally	
When I approach the exhibits, the picture changes very naturally	
I understand what I can operate and what I can't	
When I interacted with the exhibits, the feedback was as expected	
My perspective changed in line with my expectations	
I always know the directions to visit an exhibit or a museum room	Navigation
I always know where I am	
I know how to locate myself when I am lost	
I know where we start and where we end	
I can provide enough information for my students in the available exhibition fields	Learning potential
I can assess gained knowledge on the exhibition via the available fields	
I would consider discussing my VISITOR app experience with other teachers	
I would consider using the VISITOR app with my students	
I think the VISITOR app is designed for inclusivity	

Further to the virtual tours evaluation instrument, participants self-reported their demographics and the extent to which they are familiar with (a) online and digital tools for teaching and (b) virtual museum tours on a scale of 1-5 (where 1 = not at all and 5 = very much).

The five participating users were three female and two male educators with expertise in different disciplines (history, computing, art and design, and across subjects) and levels, were in the age range between 28 and 61 years old and represented participating project partners from Greece, the UK and Belgium. One of the participants was relatively familiar with the app as they gave feedback on an early version, but the other four were beginners. All participants self-reported to be somewhat (n = 2) or very much (n = 3) familiar with online and digital tools for teaching, with three reporting somewhat familiar with virtual museum tours and two, not really (Figure 5).
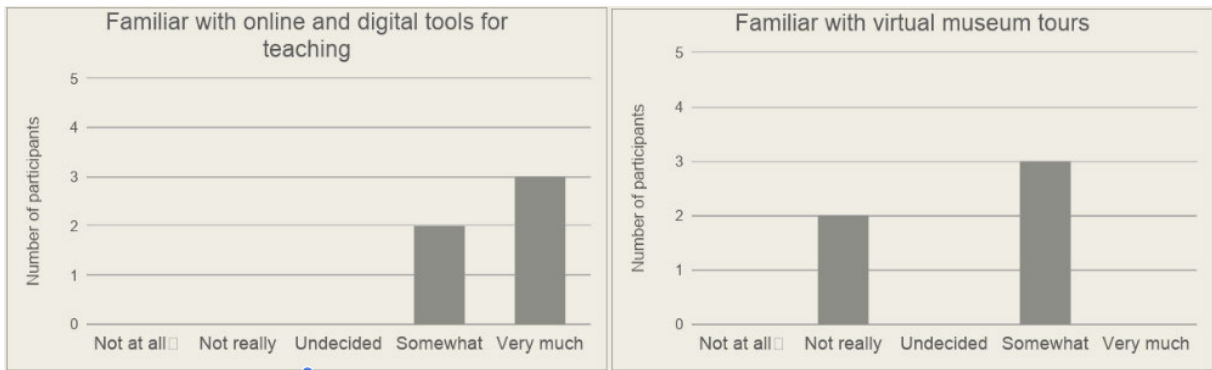
Figure 5. Survey responses (n = 5) to familiarity with online and digital schools (left) and with virtual museum tours (right)

3   RESULTS

The analysis of the virtual museum tour app evaluation indicated that overall, the users found the application usable, but some recommendations were to improve the virtual experience and learning further. The participants signed/registered with the app and set app their avatars with ease but expressed their concerns about error messages appearing in red that are not very visible, not being able to use the copy-paste function via their mouse, and not being able to change the language past the registration/sign in form.

The average score for authenticity was moderate (M = 3.35) (Figure 6), with the highest rated item being the authenticity of the artefacts, and the least realistic aspect being feeling like they are in a real museum. The latter was explained through a participant's comment in the think-aloud activity who commented that 'it could feel more real if there were more people or avatars around you'. In particular, they suggested that the museum curators could be more interactive.
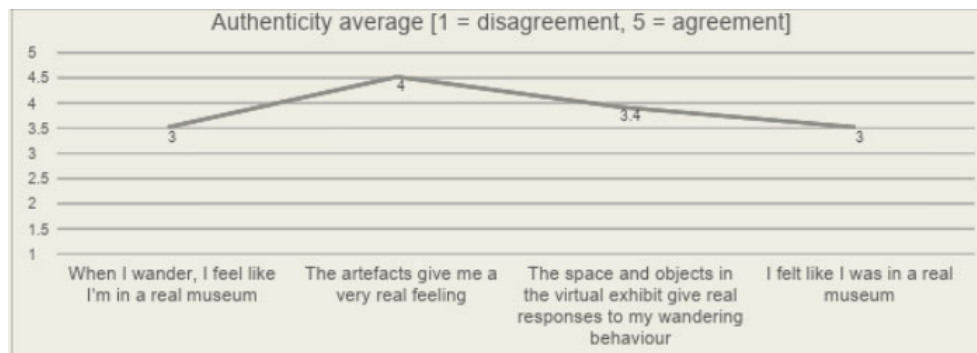

Figure 6. Virtual tour evaluation - authenticity

Navigating and locating features on the app was straightforward, with minor issues, including missing 'exit' buttons in pop-up windows, missing 'skip' buttons in tutorials, and the director's office missing from the museum app. The average navigation score was relatively high (M = 4.10) (Figure 7), with all items achieving a high agreement score. Participants in the think-aloud activity navigated around with little use of the tutorial or maps. Interacting with museum features was quite direct; however, participants with a bad internet connection had difficulty positioning themselves at the right spot to get the artefact information activated and presented. Some suggestions were to 'facilitate coming out of reading about an exhibit to re-join the room' and 'navigating using the mouse'.
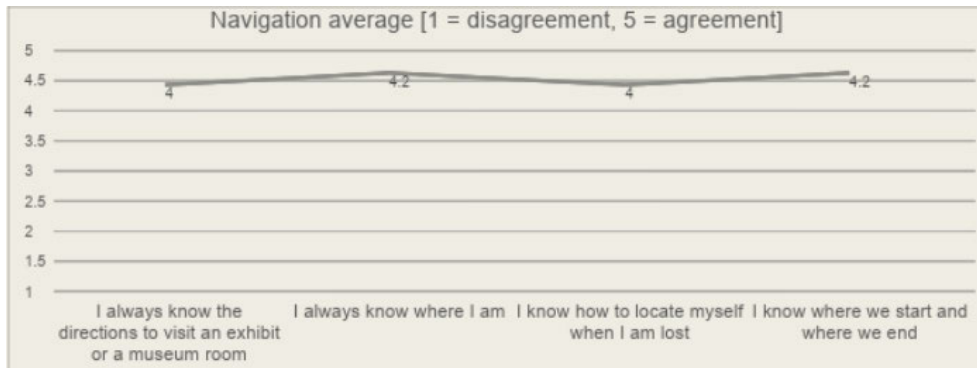
Figure 7. Virtual tour evaluation - navigation

The average score for interactivity was moderate (M = 3.43), with participants reporting higher satisfaction with the camera perspective and how their views change, and lower satisfaction with interaction and feedback when engaging with the app artefacts (Figure 8). Adding content to the app, seemed to be more challenging, with participants finding the edit menu less obvious, the slots for 2D or 3D artefacts indistinguishable, and the creation of the quiz rather difficult with issues labelling the correct and incorrect answers and lack of feedback to their actions. Participants commented that "the interaction with the green arrows were more responsive", and that "several functions (such as the quiz creation) seem not to respond or not to provide a feedback message of successful or unsuccessful completion"
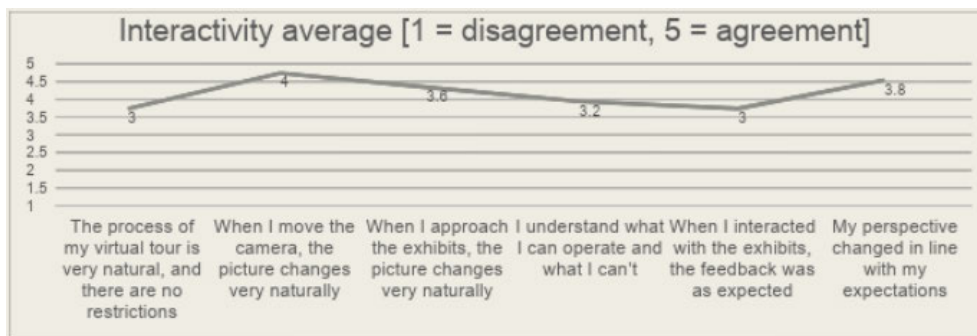

Figure 8. Virtual tour evaluation - interactivity

The average score for learning potential was also moderate (*M* = 3.56). Participants considered using and promoting the VISITOR app for use in the school classroom to a great extent. They agreed that the app provides them with the necessary tools to teach and assess to a lesser extent (Figure 9). Specifically, participants highlighted that "the available artefacts on the app are not plenty and variable enough to address several learning subjects", "quizzes are a good evaluation tool, but more tools could be added", and "assessment needs to be more diagnostic for teachers".
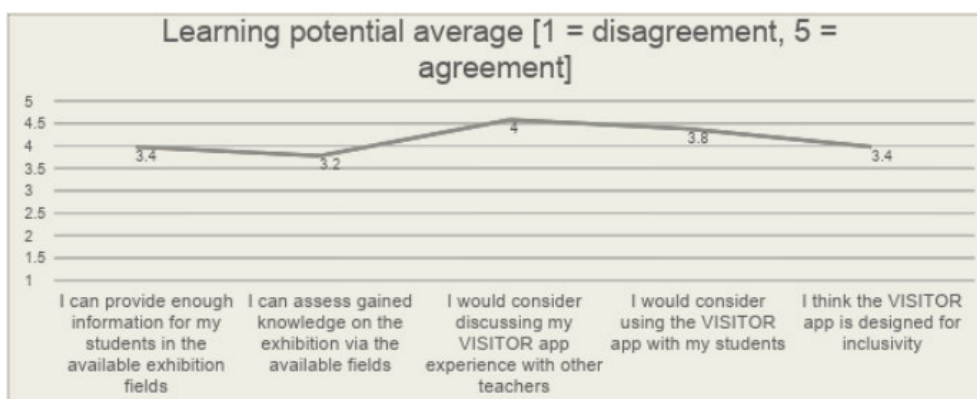

Figure 9. Virtual tour evaluation – learning potential

4 CONCLUSIONS

The VISITOR app has gone some way towards empowering teachers across subjects and levels to develop their own collection of artefacts and bring the museum experience to their classrooms. Unlike previous related studies, this study targeted the evaluation of a 'user as creator' virtual museum tour application and understand the end-user experiences with this new mode. Our findings showed that the VISITOR app can be further improved by mainly addressing the highlighted interactivity concerns, such as the lack of skip and exit buttons, distinguishing 2D and 3D artefact positions, increasing the feedback on the edit menu and the quiz creation, and ensuring that the museum map is well informed. More significantly, the redesign should focus on the app's pedagogical benefits and learning potential, allowing for more assessment types (beyond reading comprehension) and empowering the teacher with analytical tools. Although our evaluation of the application has only been at the initial stages, our critical recommendations can inform the redesign of the application, and also serve as references for consideration by exhibition or educational technology designers in the design and planning of online virtual museum tours and other virtual tour apps for schools.

ACKNOWLEDGEMENTS

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