The Impact of the 'Scientific Traveler' Mobile App on Seventh Graders' Understanding of Natural Tourist Sites in Oman

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Received 11/9/2024, Accepted 11/11/2024, Published 01/04/2025

Abstract:

This study investigated the impact of scientific concepts through using a gamification approach-based mobile application on the acquisition of scientific concepts, as well as the correction of relevant alternative perceptions about the most important natural tourism sites for seventh graders in the Sultanate of Oman.

Pre-post study was conducted using a quasi-experimental design. The sample consisted of 64 seventh-grade students, of which 33 students were assigned to be the experimental group, and 31 students were assigned to be the control group.

A mobile application called "scientific traveler" was designed based on the principles of the gamification approach, and was implemented for the experimental group. Furthermore, two tests were created and administered as pre- and post-tests for both study groups: one for their alternative perceptions of the most significant natural tourism sites in Oman, with a reliability coefficient of 0.88, and another for their acquisition of scientific concepts, with a reliability coefficient of 0.77.

The data collected by using the suitable statistical tools, then analyzed. The results showed a statically significant difference between the experimental and control groups in favor of the experimental group. This difference at a level of (α= 0.05) in the acquisition of scientific concepts test. This study also found a statically significant difference at a level of (α= 0.05) between the mean score of the experimental group and the mean score of the control group in favor of the experimental group in alternative perceptions about the most important natural tourism sites in Oman.

The study recommends that science educators and tourism officials design mobile applications based on the principles of the gamification approach to support students' acquisition of scientific concepts, and to correct their perceptions about important natural tourism sites in Oman.

Keywords: Gamification, scientific tourism, mobile application

فاعلية التطبيق الهاتفي (الرحال العلمي) على فهم طلبة الصف السابع بالمواقع السياحية الطبيعية في سلطنة عمان

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استلام البحث: ٢٠٢٤/٩/١١ قبول النشر: ٢٠٢٤/١١/١١ تاريخ النشر : ٢٠٢٥/٤/١

الملخص

هدفت الدراسة الحالية إلى استقصاء فاعلية تطبيق هاتفي مبتكر قائم على منحى التلعيب في اكساب طالبات الصف السابع الأساسي بسلطنة عمان المفاهيم العلمية المتعلقة بالمواقع السياحية الطبيعية، وتصحيح تصوراتهن البديلة حول أهم تلك المواقع في سلطنة عمان. واستخدم المنهج شبه التجريبي للمجموعتين التجريبية والضابطة. وتكونت عينة الدراسة من (٦٥) طالبة من طالبات الصف السابع الأساسي بسلطنة عمان حيث تكونت العينة التجريبية من (٣٣) طالبة والعينة الضابطة من (٣١) طالبة. وتم إعداد تطبيق هاتفي قائم على منحى التلعيب أطلق عليه اسم (الرحال العلمي)، بالإضافة إلى إعداد اختبار اكساب المفاهيم العلمية، وبلغت قيمة الثبات له (0.88)، كما تم اعداد اختبار التصورات البديلة حول المفاهيم العلمية المرتبطة بأهم المواقع الطبيعية في سلطنة عمان، والذي تم التحقق من صدقه وثباته، حيث بلغت قيمة الثبات (0.87).

أشارت النتائج الى وجود فروق ذات دلالة احصائية لصالح المجموعة التجريبية التي استخدمت التطبيق الهاتفي في كل من مقياس اكتساب المفاهيم العلمية حول المواقع الطبيعية وفي مقياس التصورات البديلة حول المواقع الطبيعية في سلطنة عمان. وتوصي الدراسة كلّاً من معلمي العلوم والقائمين على اعداد المناهج الدراسية بضرورة الاهتمام بالمفاهيم العلمية المرتبطة بالسياحة العلمية وتصحيح التصورات عنها، وتطبيق منحى التلعيب في مجالات أوسع، كما توصي الدراسة المسؤولين في قطاع السياحة بأهمية تطبيق منحى التلعيب للترويج للسياحة بشكل عام والسياحة العلمية بشكل خاص. والربط بين السياحة والتعليم من خلال المناهج والأنشطة المدرسية.

الكلمات المفتاحية: التلعيب، السياحة العلمية، تطبيق هاتفي

Chapter one

Introduction

Tourism is considered as a human activity and a global phenomenon that increases interest; it is one of the most prominent economic activities in the current century, and it has ranked second among global economic activities (Al-Anzi and Al-Dagheem, 2022). It is also viewed as the industry of the future, as it positively affects economic, social, cultural, and educational development. Further, it is a means for exchanging cultures between peoples. In addition, it promotes sustainable development, eradicates poverty, and contributes to the development of infrastructure (Al-Amri, 2020; Al-Anzi and Al-Dagheem, 2022; Giampiccoli, 2020). The UNESCO World Conference on Education for Sustainable Development, held in Bonn, Germany, pointed to the need to integrate education for sustainable development at all levels of education, learning, and training, from early childhood to higher education and adult education. This includes non-formal education and informal learning, so that lifelong learning opportunities are available in all areas (UNESCO, 2019).

The importance of tourism lies in its diversity and variety. There is religious, nature, sports, cultural, environmental, agricultural, study and scientific tourism, and work-related tourism (Al-Anzi and Al-Dagheem, 2022; Tovmasyan, 2016). Scientific tourism is one of the most important types of tourism. The World Tourism Organization has indicated that the concept of scientific tourism is used for forms of tourism that are characterized by their dependence on nature as a main motivator for tourists. It includes educational and research activities, and seeks to reduce negative impacts on natural environments (Kosiewicz, 2014). Koshim et al. (2019, p. 6) define it as: "Environmental and cultural tourism aimed at the active participation of the tourist with the aim of exchanging and sharing new scientific knowledge and ideas." Al-Anzi and Al-Dagheem (2022) indicate that environmental, cultural, natural, heritage, and adventure tourism all fall under the concept of scientific tourism. Scientific tourism includes all natural sites that have formed over thousands of years such as caves, forests, nature reserves, beaches, rocky cliffs, springs, in addition to scientific centers that humans have prepared such as specialized celestial domes, nuclear power stations, space centers, aquariums, museums, exhibitions, and scientific conferences (Alon & Tal, 2017).

Some studies indicate that the formation of scientific concepts among students at different educational levels requires a suitable teaching method and techniques to ensure their correct formation and retention for the longest possible period (Mustafa, 2014; Mughir and others, 2016). The same applies to scientific concepts related to natural, geographical, and geological tourist sites.

In recent years, many applications and programs have appeared on smartphones, focusing on using basic game elements and rules in the learning process, which is known as gamification (Caponetto et al., 2014; Chen et al., 2020). This term appeared at the beginnings of the second millennium as a motivational strategy in many areas such as business management, marketing, increasing employee productivity in some companies, and increasing sales by increasing user interaction (Dicheva et al., 2015; Miller, 2013; Papp, 2017). It has also been effectively used in the field of tourism (Miller, 2013; Papp, 2017). As for the field of education, the term gamification has become one of the most prominent terms, due to its capabilities that make students more accomplished, participatory, and engaged in learning (Caponetto et al., 2014).

From the above, it is clear that the gamification approach has played an effective role in various sectors such as tourism, entrepreneurship, and education. Researchers expect that it is possible to exploit this approach to encourage scientific tourism among school students in particular, and among citizens in general. This can be achieved through an innovative phone application based on the gamification approach. This study comes to verify the effectiveness of an innovative phone application based on the gamification approach on acquiring scientific concepts about natural tourist sites and correcting alternative perceptions about them.

Purpose of Research

The current study aims to investigate the impact of a phone application (Scientific Traveler) based on the gamification approach, on the acquisition of scientific concepts related to tourist sites, and the correction of alternative perceptions among seventh-grade students in the Sultanate of Oman.

Research Questions

The research questions consist of a main question from which two sub-questions emerge:

- What is the effectiveness of an innovative phone application based on the gamification approach (Gamification) on acquiring scientific concepts and modifying alternative perceptions related to natural tourist sites among seventh-grade students in the Oman Sultanate?

1- What is the effectiveness of an innovative phone application based on the gamification approach (Gamification) on acquiring scientific concepts related to natural tourist sites among seventh-grade students in the Oman Sultanate?

2- What is the effectiveness of an innovative phone application based on the gamification approach (Gamification) in modifying alternative perceptions related to natural tourist sites among seventh-grade students in the Oman Sultanate?

Chapter two

Scientific Tourism

Tourism varies according to its objectives, including: recreational tourism, cultural tourism, environmental tourism, educational tourism, religious tourism, therapeutic tourism, agricultural tourism, and sports tourism (Tovmasyan, 2016). The Oman Sultanate is considered one of the richest countries in terms of cultural, geographical, and geological diversity. It is characterized by the diversity of its environments, climate, and various tourist landmarks, which has made it an attractive region for both inbound and domestic tourism. Statistics from the National Center for Statistics and Information (2016) indicate a doubling of inbound tourism in the Oman Sultanate twice in the period (2005-2014) compared to domestic tourism, which tripled. These results reflect the interest of the Omani people in domestic tourism and their noticeable turnout for it. Domestic tourism contributes 97.5% of total tourism spending, equivalent to 971.1 million Omani Riyals (National Center for Statistics, 2016). Studies and reports issued by academic organizations and global tourism organizations confirm that domestic tourism is the main guarantee for the stability of the tourism industry, as it is a professional work targeting the future generation, and introducing them to the landmarks of their country (Ibrahim, 2014).

Scientific tourism represents a global concept aimed at exploring science, learning about achievements, and raising awareness about nature and the environment. It also provides an opportunity for individuals to learn and contemplate. It is an activity that encourages visitors and tourists to generate and disseminate scientific knowledge (INST, 2019). Furthermore, it is an important means of participating in the production of knowledge and transferring it to others to achieve sustainable development, and an advanced concept for scientific trips that link tourism development with creativity and innovation (Buzinde et al., 2020). In addition, it is a suitable method to highlight the importance of scientific research, and the necessity of engaging people in exchanging knowledge and disseminating it widely (Räikkönen et al., 2019).

Science curricula are among the best and most suitable curricula for addressing the concept of scientific tourism; due to the nature of the topics presented in these curricula and their close connection to it. Thus, these curricula become a means of clarification and an educational aid through setting up sequential and integrated visits, as well as planning school educational trips . Therefore, natural science books play a pioneering role in raising awareness about this type of tourism by introducing students to its concepts, types, and importance
(Al-Anzi and Al-Dagheem, 2022).

Researchers believe that integrating science curricula with tourism, using elements of the gamification approach in general, and using an innovative phone application based on this approach to link scientific tourism with scientific concepts in particular, may contribute to encouraging scientific tourism. It may also contribute to students' acquisition of scientific concepts related to natural sites in the Oman Sultanate, and in correcting alternative perceptions about these sites on the other hand.

Scientific concepts

Scientific concepts are the fundamental building blocks of science, forming the basis for generalizations, laws, and theories. The acquisition of scientific concepts contributes to the understanding and application of knowledge in solving problems that humans face, and better prepares them for the future. In addition, they assist in

predicting and planning any activity that the learner may undertake in their life (Al-Sweilemeyn and Abu Al-Sheikh, 2014; Mughir et al., 2016
Believing in the importance of acquiring correct scientific concepts and correcting alternative perceptions among students, educators have made strenuous efforts and produced various models and strategies. In light of the technological and knowledge revolution, a number of studies have focused on using technology to modify alternative perceptions among learners using simulation, virtual reality, and augmented reality in teaching scientific concepts, such as the study by Tomara et al., 2017. They also employ computer simulation models, as in the study by Ersoy & Dilber, (2014); Wade-Jaimes et al. (2018). Many studies point to the effectiveness of educational computer games, as the study by Ahmed (2016), which point to the effectiveness of educational computer games in acquiring and retaining mathematical concepts . From what has been presented, researchers believe that the trend towards gamification can play a major role in acquiring scientific concepts and correcting alternative perceptions .

Gamification

The gamification approach is one of the most important modern trends that has spread widely in all areas of life including tourism, entrepreneurship, health, and education. It refers to the use of game elements in non-game contexts with the aim of engaging individuals in a variety of tasks (Borges et al, 2014). Erenli (2013, P.4) defines gamification as: "The process of using game thinking and mechanisms to engage or merge with audiences and solve problems". From the previous definition, researchers conclude that gamification in education is the use of main game elements but in a broader concept; to create interesting experiences that have an educational return, and the gamification approach is based on a set of main elements. The most important elements of play that the gamification approach is based on, as stated in (Al-Qahtani and others, 2016; Qarni and Abu Saif, 2016; Al-Qazzaz, 2018; Gafni et al., 2018; Kallioja, 2017), are: points, honor board (leaderboard) and points store, badges, stages, challenges, characters (avatar), progress bar, feedback mechanisms, social participation, and other elements.
Gamification has many benefits, as studies point out its effectiveness in developing positive attitudes for students towards education, raising motivation, and growing self-motivation (Carrillo et al., 2019; Hursen & Bas, 2019; Khan et al.,2017), and improving performance and learning outcomes (Shaheen, 2020; Ali, 2021). The gamification approach has enhanced students' motives and endowed them with a technique to improve their skills for their professional future (Al-Shammari, 2019; Al-Ghamdi, 2020). Al-Ajlan and Al-Qarni (2018) point out the effectiveness of employing gamification in developing students' writing skills. The gamification approach has proven its effectiveness in helping students acquire technological concepts (Al-Qazzaz, 2018) and mathematical concepts (Al-Hafnawi, 2017). Additionally, Al-Ghamdi (2020) indicate that mobile phone applications make education more effective by influencing cognitive, emotional and social fields,

while recent research studies indicate a lack in employing technology in general, and gamification in particular in the educational process (Shaheen, 2020; Al-Shammari, 2019; Al-Ajlan and Al-Qarni, 2018; Al-Ghamdi, 2020; Egenfeldt-Nielsen, 2010).

The previous discussion highlights the role of the gamification approach in many areas, including the acquisition of concepts, becomes clear. Al-Azzab and Abdel Momen (2019) explaine a weak employment of the gamification approach aimed at developing tourism activity, and they recommend the necessity to employ technology to activate scientific tourism. This study comes in line with the national priorities of Oman Vision (2040), which is represented in citizenship, identity, heritage and national culture.The study seeks to create a society capable of evaluating, criticizing, employing, producing and disseminating knowledge. In addition to the national priority represented in the environment and natural resources, the study aims to create a balance between the requirements of economic and social environment, working according to the rules of sustainable development; sustainable use of resources, and natural wealth and investing it. The study aims to achieve the national priority represented in education, learning and research by achieving comprehensive education, and sustainable learning, and research leading to a knowledgeable society; competitive national capabilities; raising the quality of school education and educational programs; ensuring the use of modern education and learning technologies, and spreading them as a national culture. Moreover, the study emphasizes the necessity of focusing curricula and educational programs on cultural components and landmarks, and tourism components (Oman Supreme Council for Planning, 2019).This study comes as a response to the recommendations of the Education Council in the Sultanate of Oman to exploit gamification optimally and its role in many sectors (Omani Education Council, 2019), including education and tourism sectors. The study also seeks to achieve Sustainable Development Goals by achieving the fourth goal of the Sustainable Development Goals, which calls for offering good education and achieving sustainable development, as well as achieving the 11th goal, which is represented in sustainable cities and local communities (US, 2015).

Based on previous studies, we find that tourism concepts have been concentrated in the social studies curriculum, as shown in stydies by Ridwan (2018) and Al-Amri (2012). The current study aligns with studies by Al-Anzi and Al-Dagheem (2022) in focusing on scientific tourism in the science subject. Some studies have analyzed textbooks and compiled lists of tourism concepts in general, such as Ridwan (2018). Regarding educational stages, Al-Anzi and Al-Dagheem (2022) explored secondary stages, while Ridwan (2018) studied primary stages. This study agrees with Al-Amri (2012) in emphasizing the intermediate stage. It differs from previous studies in employing a quasi-experimental approach and by incorporating technology through an innovative phone application based on the gamification approach.

Chapter three

Methodology

Population and Sample

The study community consists of all seventh-grade female students studying science in government schools affiliated with the General Directorate of Education in Muscat Governorate during the first semester of the academic year 2022/2023.

The study participants were selected intentionally, and the sample consist of 64 seventh-grade students from a government school for basic education (grades 5-10) in Muscat Governorate, the Oman Sultanate. This selection was made possible due to teacher cooperation at that school. In the education system of the Oman Sultanate, there are two main stages: the first stage is called basic education, includes grades one to ten, while the second stage is called post-basic education for grades eleven and twelve.

Design and Procedure

The quasi-experimental approach was used by conducting pre and post-application, on the two groups. The study includes a control group consisting of 31 students who were taught using traditional methods, and an experimental group consisting of 33 students, who utilized the phone application (Scientific Traveler). Students in the experimental group were allowed to use the application at school four times a week, in addition to using it at home. The aim was on maximizing usage during the mid-year school holiday, from December 24,2022, to January 19,2023, which provided an ideal opportunity for students to engage in domestic tourism and make effective use of the phone application. The pre-application of the tests acquiring scientific concepts, and detecting alternative perceptions related to natural tourist sites in the the Oman Sultanate was administered on both experimental and control groups. The post-application of both tests was also applied on experimental and control groups.

Study Materials and Instrument:

The researchers developed an enrichment unit and a gamification-based mobile application in collaboration with a specialized software company. The study tools include a test for assessing scientific concepts and a test designed to detect students' alternative conceptions. Below is a detailed explanation of the study materials and tools:

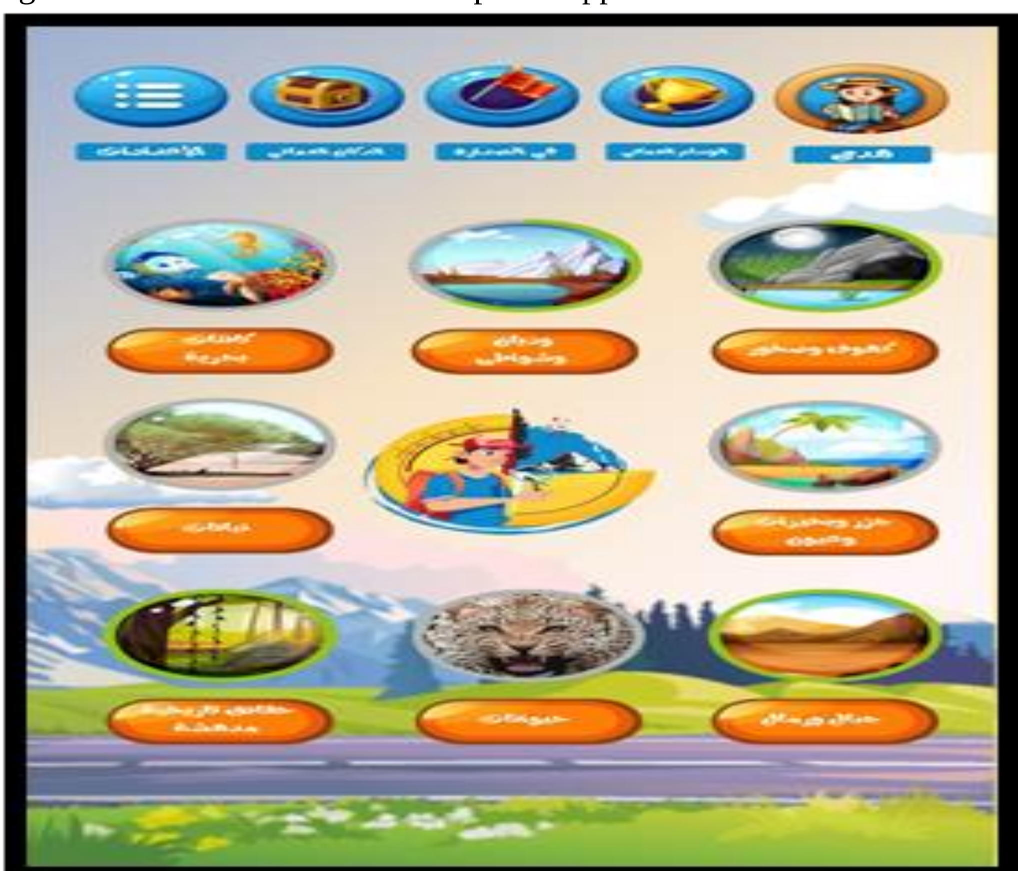
Materials and Devices:

Enrichment Unit: An enrichment unit was developed focusing on the most important scientific tourist sites across various governorates in the Sultanate of Oman. It was developed by surveying the tourist sites in cooperation with research assistants specializing in the field of tourism. These sites were then analyzed in terms of the scientific concepts related to them, as well as any alternative conceptions that might exist. The content was validated by presenting it to several specialists from the Department of Geology at Sultan Qaboos University, and specialists from the Environment Conservation Office in the Oman Sultanate.

A gamification-based mobile application was designed to teach scientific concepts related to natural tourist sites in the Sultanate of Oman to seventh-grade students, while also addressing alternative conceptions about these sites. The application was developed in cooperation with a private programming and design company. It consists of several creatively designed sections, developed according to gamification principles. Below are the main interfaces that make up the application:

1. **Main interface and application logo**: The main interface and application logo were distinctively designed to reflect the overall theme of the project, which focuses on scientific tourism. The application is divided into several sections, including caves and rocks, islands, lakes and springs, rocks and mountains, Omani animals, Omani plants, marine creatures, amazing historical facts, mountains and sands. Figure 2 illustrates these sections.

Figure 2 The main interface of the phone application



2. **Front Interface**: This interface mimics an honor board in a playful context, creatively incorporating some of the most famous natural tourist landmarks. Players progress from one level to the next by earning a certain number of points. The front section is divided into five levels: Sawadi Beach

(0-100 points), Green Mountain (101-200), Wahiba Sands (201-300), Musandam Beaches (301-400 points), and Diving near the Dimaniyat Islands (401-500 points). As players accumulates points, they advance through the levels. Figure 3 shows an example of one of these interfaces.

Figure3: One of the interfaces in the "In the Lead" section

3.**Explorer Interface**: This section displays the most important facts and scientific concepts about some tourist sites in an attractive design. students get an additional point when they click on the "Completed Reading" button for each new piece of information they read.

4.**Ready Interface**: This section displays a series of multiple-choice questions for each section in the application as shown in Figure 2, and the player gets a number of points for their correct answers.

5.**Present Interface**: In this section, players are allowed to visit natural tourist sites and upload photos, and link them to GPS location. Others can interact with players by pressing the “like” icon on the photos, and get additional points for each “like” received.

In addition, the application includes other sections such as player's profile, which shows the level of progress in each section, and the Omani Medal section where players get medals for specific achievements, and the Omani Shop section which allows students to exchange points for certain goods. The application was designed to be used by people with visual and hearing disabilities, as they can adjust the font type and size, the degree and sharpness of colors, and other amendments.

The Study Tools

Scientific Concepts

The researchers developed a test that measures the extent to which students acquire scientific concepts related to natural tourist sites in the Sultanate of Oman, which carry a scientific character and scientific interpretations. The validity of the scale was verified by a group of arbitrators from the Department of Earth Sciences at Sultan Qaboos University and the Office of Environmental Conservation in the Sultanate of Oman. Its stability was also verified, where the value reached (0.88).

Alternative Perceptions

The researchers developed a test to detect alternative perceptions among students about the most important information and concepts related to natural tourist sites, and its validity was verified by a group of arbitrators from the Department of Earth Sciences at Sultan Qaboos University and the Office of Environmental Conservation in the Sultanate of Oman. Its stability was also verified, where the value reached (0.87).

Equivalence between the two groups:

To verify the equivalence of the experimental and control groups for the acquisition of scientific concepts test and the alternative perceptions relate to natural tourist sites test, the "t" test for independent samples was used, as shown in Table 1.

Table 1

Results of the "t" test for independent samples regarding the differences between the experimental and control groups in the pre-application of acquiring scientific concepts test and the alternative perceptions related to natural tourist sites in the Oman Sultanate test

Variable	Group	N	Mean	SD	(t)	Sig.
Acquisition of scientific concepts	Experimental	33	4.76	1.88	0.364	0.794
	Control	31	4.60	1.64		
Alternative perceptions of scientific tourist sites	Experimental	33	5.45	2.29	0.264	0.494
	Control	31	5.29	2.67		

Table 1 shows no statistically significant differences between the two groups in the pre-application the tests of both acquiring scientific concepts and detecting alternative perceptions related to natural tourist sites. The probability "t" value was greater than the significance level (α=0.05), thus it can be concluded that the two groups are equivalent in the pre-measurement for both tests.

Study Application Procedures

1.Reviewing Arabic and foreign educational literature and previous studies to form an appropriate theoretical background about the study topic and develop its tools.

2. Developing an enrichment unit about the natural sites in the Sultanate of Oman, designing a phone application based on the gamification approach, and presenting the study materials to specialists to ensure their validity.
3. Developing a test to measure the acquisition of scientific concepts related to natural tourist sites in the Sultanate of Oman, and a test to detect alternative perceptions among students about the concepts related to natural sites in the Sultanate of Oman, and presenting them to arbitrators to verify their validity.
4. Selecting the study sample that consist of 64 seventh-grade students from a school in Muscat Governorate, and conducting training workshops to train teachers to teach students using the application.
5. Calculating the stability for the acquiring concepts test and detecting alternative perceptions among students test, using the internal consistency method by applying it to a sample similar to the study sample.
6. developed The pre-application of the tests on both the experimental and control groups.
7. The actual application of the study, and students following up during the application period.
8. The post-application of both the test of acquiring scientific concepts and the test of detecting alternative perceptions related to natural tourist sites in the Sultanate of Oman.
9. Statistical analysis of the results using SPSS program, followed by presentation and discussion of the results. Finally, providing appropriate suggestions and recommendations in light of the results obtained from the study.

Results and Discussions

This study aimed to explore the impact of using an innovative phone application based on the gamification approach to teach and enable seventh-grade female students to acquire scientific concepts related to natural tourist sites in the Sultanate of Oman, and to detect their alternative perceptions related to some of these sites in the Sultanate of Oman. The study seeks to answer two questions. The results will be discussed separately according to the questions.

To answer the first question, which states "What is the effectiveness of the innovative phone application (Scientific Traveler) based on the gamification approach on seventh-grade female students acquisition of scientific concepts in the Sultanate of Oman?" The test of acquiring scientific concepts was applied immediately after the completion of the project application. The means and standard deviations of the performance of the experimental and control study groups were calculated. The "t" test for two independent samples (Independent-Samples T-test) was used to calculate the significance of the differences between the averages of the experimental and control groups for the test of acquiring scientific concepts, and to calculate the effect size, as shown in Table 2.

Table 2

Results of the "t" test between the experimental and control groups in the test of acquiring scientific concepts related to natural tourist sites in the Sultanate of Oman

Group	Number of phrases	Mean	SD	Impact size	The value of(η2)	Semantic level	The value of (t)
experimental	22	19.5	2.20	Big	0.91	0.01*	28.46
control		5.35					

The results related to the first question show statistically significant differences at the significance level (α=0.05) between the experimental and control groups in the test of acquiring scientific concepts related to natural tourist sites in the Sultanate of Oman. The significance level was (0.010). Reviewing the arithmetic means in table 2, it can be noticed that these differences are in favor of the experimental group that used the innovative phone application (Scientific Traveler). Regarding the effect size, it is found that the effect size caused by the phone application in acquiring scientific concepts related to tourist sites among seventh-grade female students was large. According to Cohen's classification (Cohen, 1988), who indicate that the effect size by Eta is considered large if its value exceeds (0.14). This statement suggests that the percentage the independent variable, which is the phone application based on the gamification approach (Scientific Traveler), explains that the total variance of the dependent variable (acquiring scientific concepts related to natural tourist sites) equals 91%.

To know the growth caused by the phone application on acquiring scientific concepts among seventh-grade students, the growth amount for the two groups was calculated using the "t" test for the related samples, as shown in Table 3.

Table 3

Results of the "t" test for the related samples to measure growth in the test of acquiring scientific concepts for the study groups.

Group	Measure	Mean	SD	Sig.	t	F
experimental	Pre-concept test	4.77	1.89	*0.001	28.94	32
	Post- concept test	19.51	2.20			
control	Pre-concept test	4.58	1.63	0.106	1.67	30
	Post- concept test	1.47	4.90			

Statistically significant at the significance level (α= 0.05)

Table 2 shows statistically significant differences in the experimental group between the pre and post applications of the acquiring scientific concepts related to tourist sites in the Sultanate of Oman test. This result indicates a growth in the acquisition of scientific concepts among seventh-grade students as a result of using the phone application based on the gamification approach. These results reflect the role that the phone application plays on acquiring scientific concepts, as the phone application focuses on enabling students to acquire scientific concepts and facts in an interesting and attractive design using colors, sounds, and vibrations that stimulate the player to read in the "Explorer" section. The player also gets points when they complete reading the information, in addition to the "Ready" section which measures the extent to which the student benefites from the information in the "Explorer" section, by answering a set of multiple-choice questions.

One of the students (E13) indicate that she was mostly attracted by the amount of strange and new facts and concepts she encountered for the first time about Oman, particularly information about the natural tourist sites she used to visit such as the Green Mountain, Al-Anafif Cave, the Marble Cave, and Majlis Al-Jinn Cave. The student (E7) indicate that her view of the natural tourist sites has completely changed, as she started to think more often about these natural sites that she had visited, and the plants, animals, and birds that she had seen. She links her observations to scientific facts. One of the parents indicate that he personally benefited from the information provided in the application. Continuous use of the application by students after the trial period confirms its success. This success is revealed in the increase in the number of posts and photos uploaded in the "Souvenir" section, and the increase in interaction for the uploaded photos during the mid-year school holiday, which was an ideal period for travelling, tourism, and discovery due to good weather conditions.

Regarding the value of the effect size, the researchers attribute the reason for the large value of the effect size to the creative capabilities, unusual ideas of the phone application, interaction that the application creates between individuals, and its ability to mimic students' real life not relying only on theoretical information. The researchers believe that the application may have succeeded in promoting scientific tourism in an innovative way, as well as linking tourism with science, as emphasized by studies and conferences. Al-Azzab and Abdul Momin (2019) recommend tourism marketing through electronic games based on gamification. The second World Conference of the World Tourism Organization and UNESCO on Tourism and Culture, which was held in Muscat in the Sultanate of Oman during the period 11-12 December 2017, suggests encouraging innovation of models that present cultural tourism, where tourism and culture play a major role in achieving the seventeen sustainable development goals and the 2030 plan
(Oman Newspaper, 2017). The World Tourism Day (2023), carried the slogan
(Investing in People and Planet and Prosperity), and one of its recommendations state the need to find new and innovative solutions to replace traditional investments and enhance and support economic and productive growth (UNWTO, 2023). Several studies indicate that one of the main obstacles of scientific tourism is the lack of planning for it, and the scarcity of products that encourage it
(Bloom, 2010; Räikkönen et al., 2019).

To answer the second question of the study that states "What is the impact of using an innovative phone application based on the gamification approach on modifying alternative perceptions related to natural tourist sites in the Sultanate of Oman?", the post-test of alternative perceptions was applied to measure the performance of the experimental and control groups. The "t" test for the two independent samples (Independent-Samples T-test) was used to calculate the significance of the differences between the averages of the experimental and control groups in the test, as shown in Table 4.

Table 4

Results of the "t" test to calculate the differences between the average scores of the students in the study groups for the test of alternative perceptions related to natural tourist sites in the Sultanate of Oman.

Group	Number of phrases	Mean	The standard deviation	The value of (t) at D.H (62)	Sig.	The value of (η2)	Impact size
Experimental	20	16.91	2.185	15.298	0.000	0.79	big
Control		5.71	3.551				

Statistically significant at the significance level (α= 0.05)

Table 4 shows statistically significant differences between the average scores of the experimental and control groups for the test of detecting alternative perceptions about natural tourist sites in the Sultanate of Oman. Reviewing the arithmetic means, it is noted that these differences are in favor of the experimental group. Regarding the effect size, it is found that the effect size caused by the phone application to correct alternative perceptions related to tourist sites among seventh-grade female students is large, according to Cohen's classification (Cohen,1988). To determine the growth caused by the phone application in correcting alternative perceptions related to scientific tourist sites among seventh-grade female students, the growth amount for the two groups was calculated using the "t" test for the related samples, as shown in Table 5.

Table 5

Results of the "t" test for the related samples to measure growth in the test of alternative perceptions for the study groups.

Group	Measure	Mean	SD	Sig.	t	F
experimental	Pre-alternative test	5.242	2.18	*0.001	35.302	32
	Post- alternative test	16.909	1.98			
control	Pre- alternative test	2.67	0.48	0.277	1.11	30
	Post- alternative test	3.55	0.64			

The table shows statistically significant differences in the experimental group between the pre and post applications of the test of detecting alternative perceptions related to natural sites in the Sultanate of Oman. This result indicates a growth in modifying alternative perceptions related to natural tourist sites among seventh-grade students as a result of using the phone application based on the gamification approach, while there are no statistically significant differences between the pre and post applications for the control group.

The researchers explain the reason for the statistically significant differences between the arithmetic means of students' scores in the experimental and control groups for modifying their alternative perceptions to the focus of the phone application on correcting alternative perceptions related to some tourist sites, and presenting new information in an interesting and curiosity-provoking method, in addition to the distinctive design of the phone application.

The researchers believe that one of the main reasons for the superiority of the experimental group is students' familiarity of some sites and their prior visits to these sites. However, this is their first time to encounter this type of information. This result may agree with the study by Räikkönen et al., (2023) which sought to identify tourists' motive for nature-based scientific tourism in a study applied to 518 tourists. The results reveal that tourists were primarily interested in science and scientific tourism products, particularly guided tours that involve scientific interpretation of the sites.

Figure 3 shows a number of scientific facts that students find spectacular, and aroused their curiosity, which were corrected during the application of the study. When students were asked, in the survey prior to implementing the study, about the reason for the formation of the tourist site (Star Identity) in Figure 4-A, they answered that it was caused by a fall of a star that led to the formation of this hole, while some students mentioned that the reason is the fall of a comet, which are the same rumors circulating about this site. However, scientific evidence indicate that the site is a dissolution hole that used to be a cave formed from sedimentary rocks in the past. The flow of valleys from the surrounding mountains led the top of the cave and its erosion to melt, forming the current dissolution hole known as called Star Identity (Ministry of Tourism, Oman, 2020). As for Figure 4-B, which shows the pink lakes in Al-Jazer state, students indicate in the survey that the reason for their formation is a pink dye that exists in the soil, but studies indicate that the reason for this dye is a type of Algae called Dunaliella, which blooms in saline soil forming this color in the lakes (Ministry of Tourism, Oman, 2020). Finally, for the site (Rock Garden) in Al-Duqm state, a number of students indicate in the survey that the shapes were formed by the Omani man hundreds of years ago, whereas these shapes are the result of wind erosion factors on the region
(Ministry of Tourism, Oman, 2020).

Figure 4 Some models of natural tourist sites included in the application.

The application includes many amazing facts in the form of information that help and encourage students to continue reading and earning points. Many students indicate that these facts encourage them to visit these sites and learn more about them from near distance. Student (E33) indicate that her visit to these sites after exposure to the phone application was different. She spent her visit contemplating and discovering, and told her family the correct information.

Chapter four

Conclusions, Recommendations and suggestions for further studies:

The study reveals some significant results about phone application based on the gamification approach. The results include the superiority of the experimental group that utilized the phone application (Scientific Traveler) over the control group that did not use the phone application in both the acquisition of scientific concepts related to natural tourist sites, and in corresction of alternative perceptions related to these sites in the Sultanate of Oman. Moreover, the study found a growth in acquiring scientific concepts and in correcting alternative perceptions in the experimental group in the post-application compared to the pre-application. The researchers attribute this result to the creative design of the application, its comprehensiveness and inclusion of attractive factors such as sections (In the Lead); (Omani Medal); and (Souvenir); where the pictures taken by players are uploaded. In addition, it provides enriching information in section (Explorer), and entertaining challenges in section (Ready). This result agrees with several studies that discuss the effectiveness of gamification elements in acquiring concepts, attracting attention, and raising the level of presence and participation (Al-Hosni and Al-Balushi, 2023).

The research factors were represented in collecting scientific information about a large number of tourist sites, verifying the scientific accuracy of the information, and facilitating it to be understood by non-specialist readers: like children and ordinary people.

In light of the above, the study recommends the following:

- Linking science curricula in particular to natural tourist sites in the Sultanate of Oman.
- Developing interest in the gamification approach and its application in various fields, whether related to education or other aspects of life.
- Developing interest in gamification as a tool that contributes to the continuity of self-learning outside the school walls.
- Encouraging students to go for scientific tourism, and spread the culture of scientific tourism when visiting natural tourist sites in the Sultanate of Oman.
- Using the enrichment phone application (Scientific Traveler) to conduct other studies, and at different study stages and different categories of students.
- Encouraging the design of applications based on the gamification approach and focusing on developing attitudes towards scientific tourism and other types of tourism.
- Involving stakeholders in scientific tourism in the Sultanate of Oman when planning and designing science curricula.

Acknowledgments:

The researchers would like to thank and appreciate the Scientific Research Council affiliated with the Ministry of Higher Education and Research and Innovation in the Sultanate of Oman for their partial support for the research: RC/GRG-EDU/CUTM/20/01-Call2021

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