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Factors influencing visitor satisfaction at selected caves in Slovakia

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ABSTRACT

This study aims to identify and evaluate the factors influencing visitor satisfaction in selected caves in Slovakia, with a particular focus on their relative importance and impact on overall satisfaction. A survey was conducted with 400 respondents – visitors to six caves managed by the Slovak Caves Administration. The analysis employed the importance-performance analysis (IPA) method alongside importance and satisfaction indices to assess objective satisfaction factors. These factors were ranked using the Friedman and Wilcoxon test, while relationships between subjective factors and satisfaction were examined through non-parametric methods, including Spearman's correlation coefficient, the Mann-Whitney U test and the Kruskal-Wallis test. Ordinal logistic regression was used to determine the combined influence of objective and subjective factors on overall visitor satisfaction. The results indicate that several objective factors significantly affect satisfaction: group size during a tour, the tour route itself, cleanliness of exterior and entrance areas, cave location and accessibility, souvenir shop services, quality of the guide's commentary and parking facilities. Among subjective factors, only the organization of the visit showed a statistically significant effect on overall satisfaction. These findings offer valuable insights for the strategic management and development of speleological tourism in Slovakia and may support efforts to enhance the competitiveness of Slovak caves on both domestic and international tourism markets.

KEYWORDS

visitor satisfaction, cave product, services, speleological tourism, importance-performance analysis

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1. Introduction

Motives such as learning and education, exercise, health and adventure encourage active tourists to visit caves. They are places of multidisciplinary education, interpretation of human history and environmental dynamics (Bajić et al., 2024). Caves, which appear on the tourism market as natural attractions, are specific spaces that integrate diverse natural and anthropogenic elements. Although these phenomena are the essence of their product on the tourism market, the multi-optional structure of visitors' needs, and growing competition among attractions on the market, currently place an emphasis on the continuous expansion and improvement of the product in the context of applying sustainable principles. The aim is not only to provide services to visitors, but also to protect and improve the environment around the attraction, ensuring that visitors feel at ease during their stay (Ramadhan et al., 2024). In addition, it is the task of management to monitor and perform comparative analyses of the speleological tourism market and improve the content and marketing strategies of caves by promoting creativity and information technology (Antić, Tomić & Marković, 2022).

In order to better adapt the product to the current requirements of visitors, it is therefore necessary to continuously monitor their satisfaction and subsequently to plan and manage cave tourism activities in such a way that will be the basis for successful innovations and an incentive for repeat visits.

2. Theoretical framework

Speleological tourism (speleotourism, cave tourism) is frequently associated with a karst area, a specific type of relief characterised by unique morphological and hydrological phenomen. It is a landscape formed by the dissolution of highly soluble rocks such as limestones, dolomites, gypsum, anhydrite, halite and their conglomerates, and is characterised by the presence of surface forms as well as extensive underground water systems and caves (Ezersky et al., 2023). On the surface, these processes are manifested in typical karst landforms such as karren and sinkholes, while underground forms are caves created by the action of water on soluble rocks (Jákal et al., 1982). The Act of the National Council of the Slovak Republic No. 543/2000 Coll. on the Protection of Nature and Landscape defines a cave as an accessible hollow underground space within the Earth's crust, formed by natural processes, the length or depth of which exceeds 2m and the dimensions of the surface opening are smaller than its length or depth. From the perspective of accessibility, caves are divided into accessible and inaccessible. Among accessible caves, there are show caves, which have been adapted for tourists with walkways, lighting and other facilities, and wild caves, which are not adapted for tourism and typically require special equipment or speleological supervision. Inaccessible caves are those into which entry is impossible due to natural conditions or legal protection ("Cave tourism: Understanding responsible travel and its impact on caves", 2025; Národná rada Slovenskej republiky, 2002).

In terms of tourism, caves as natural attractions are part of the primary tourism offer (Gúčik, 2010). They are categorised as protected natural assets that are visited by groups of guided visitors who have the opportunity to learn about natural phenomena, cultural and historical values while actively relaxing (Béki et al., 2016). When used appropriately, they are essential for tourism development as they can increase economic, social and environmental benefits for the host community quite quickly (Čech et al., 2021).

Interest in caving tourism research is currently growing, confirmed by recent studies focusing on exploration in the context of sustainable management and conservation of caves (Bajić et al., 2024; Chiarini et al., 2022; de Araujo & Lobo, 2023; Piano et al., 2024), visitor motivation (Antić, Vujičić et al., 2022), visitor health effects (Lang et al., 2024) and visitor satisfaction (Gadekar, 2023; Rajagukguk et al., 2025; Ramadhan et al., 2024).

In today's increasingly competitive attractions, the priority for the long-term sustainability and success of caves in the tourism market is to focus on visitors who increasingly demand experience and authenticity. This trend is supported by empirical studies showing that such visitor satisfaction is strong as evidenced in heritage cave tourism in India and Iran (Gadekar, 2023; Gaikwad, 2020; Shavanddasht et al., 2017). From a tourism perspective, it is therefore important not only to make cave systems physically accessible, but also to implement strategies aimed at maximising such visitor satisfaction. The long-term operation of caves in the tourism market requires knowledge-based management. Given the current dynamics of the environment, it is becoming a trend to replace the complex, time-consuming analysis of the entire micro- and macro-environment of the attractions of caves in tourism by examining only the most important factors that most influence visitor satisfaction and thus also contribute to the competitiveness This can be stimulated or hindered, and represents their strengths or weaknesses and even competitive advantages or disadvantages which, according to Slávik (2009), arise mainly within its organization, but it is not excluded that some of them are also related to its microenvironment.

ISO 10001:2018 defines satisfaction as the degree to which a visitor's requirements are met (International

Organization for Standardization, 2018). It is also a determinant of the quality of a visit as well as the quality of the attraction, i.e. the performance of attraction operators in terms of providing services to visitors. The main indicators of visitor satisfaction include experience and behavioural intentions towards attractions (Gaikwad, 2020).

Gúčik (2011) extends the overall satisfaction of visitors by sub-satisfactions, which may have differing weights in an evaluation. Also according to Huh (2002) and Gadekar (2023), it is necessary to survey satisfaction separately through individual attraction services and products. In this regard, Dela Cruz et al. (2019) evaluated guest satisfaction based on the TOURQUAL dimensions, focusing on access, environment, human element, experience, safety and technical quality. Gaikwad (2020) measured visitor satisfaction at Ajanta Cave in India based on 29 identified factors, e.g. scenic beauty of the surrounding scenery of the cave, architectural beauty of the cave, availability of a guided tour, parking facilities, promptness of ticket sales, staff behaviour, accommodation and food options in the vicinity of the cave, and others. Similar satisfaction factors were identified and analyzed by Gaikwad et al. (2020) in a study to investigate the satisfaction and loyalty of visitors to Ellora Caves. Gadekar (2023) considered 15 satisfaction factors namely: accommodation, transportation, food facility, cleanliness, personal safety, medical facility, parking, drinking water, guides, cafeteria, cave archaeology, shopping facilities, security, toilets and mobile networks, while calculating a satisfaction index for Ajanta cave visitors. In Slovak conditions, the issue of cave visitor satisfaction is not sufficiently elaborated. Mitríková and Baranová (2018) compared the satisfaction of domestic and foreign visitors with the services of the Belianska Cave, evaluating information, transport accessibility, guide, catering and leisure services in the vicinity of the cave.

According to Nowacki (2013), in addition to satisfaction factors that are the result of the systematic work of tourism attraction management (the so-called attraction characteristics), it is also important to pay attention to visitor characteristics that cannot be influenced by management (e.g. gender, age and social status, but also visitor motivation and attitudes). These groups of factors do not act in isolation on visitor satisfaction, but interact with each other.

Likert scales are often used in practice to measure satisfaction (e.g. Gaikwad, 2020; Gaikwad et al., 2020; Gúčik, 2011; Naidoo et al., 2011). Visitors rate the features (attributes) of different product components with weights (values), either verbally or numerically. Based on the sub-weights, Januška (1981) expresses the satisfaction of visitors by the so-called 'satisfaction coefficient', which is determined as the ratio of the sum of the values according to the observed attributes and number of observed attributes. The values obtained range from 0 to 1, with 0 indicating *maximum dissatisfaction* and 1 indicating *maximum satisfaction*. In addition to the satisfaction rate of an individual visitor, Gúčik (2011) and Gadekar (2023) also report the calculation for a group of visitors by the so-called average satisfaction coefficient, which is the ratio of the sum of individual satisfaction coefficients and the number of surveyed visitors.

However, in the context of satisfaction surveys, Ritchie et al. (2008) point out that not all product features are equally important to visitors of tourism attractions. Satisfaction ratings with a link to importance, which are also applied in the tourism industry by De Nisco et al. (2015), Deng and Pierskalla (2018) and Suyanto et al. (2020), create a more comprehensive picture of the factors that influence visitors. Starting from the approach of Martilla and James (1977), it is therefore appropriate to use the so-called "importance-satisfaction analysis", which allows detection through individual product features taking into account their importance for visitors. This method was also used by Jasso Barron and Xu (2024) in a study aimed at investigating the satisfaction of visitors to caves in Missouri State.

The importance-performance analysis (IPA) distinguishes between so-called experience features (e.g. uniqueness, fun, opportunity to learn something new) and features related to other services and amenities of attractions (staff friendliness, parking options, information services). The importance of each feature is rated on a five-point scale (absolutely unimportant to absolutely important). A five-point scale (1 – *very dissatisfied* to 5 – *very satisfied*) is also used to express the level of satisfaction with each feature. The result is a scheme that shows the differences between the importance of product features to visitors and satisfaction with them (Homburg & Rudolph, 1995; Martilla & James, 1977; Ritchie et al., 2008) (Figure 1).

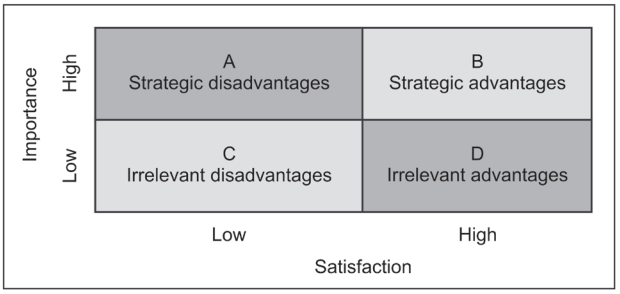

Figure 1. Importance-performance analysis (IPA) scheme of visitor satisfaction with attraction features
Source: adapted from Martilla and James (1977), Homburg and Rudolph (1995), Ritchie et al. (2008)

Quadrant A in Figure 1 represents product features that are above average in importance to visitors but

below average in satisfaction. Homburg and Rudolph (1995) refer to these as so-called strategic disadvantages. Management should strive to make them more relevant to visitor demands. Quadrant B includes the product features that are both most important to visitors and with which they are satisfied. These are strategic advantages, and management should strive to maintain their high level. In contrast in quadrant C, visitors are not sufficiently satisfied with the product attributes. As they are not even of above average importance, they represent, according to Homburg and Rudolph (1995), so-called irrelevant disadvantages. Management should carefully evaluate whether to allocate resources to improve these features, given their relatively low importance to visitors. The product features in quadrant D, although not important to visitors, are sufficiently important that they are satisfied with them. These are therefore so-called irrelevant benefits. According to Ryan and Cessford (2003), their relevance to visitors can be enhanced by management marketing activities.

The level of satisfaction achieved influences visitors' decision-making in the future. Naidoo et al. (2011) therefore recommend that in addition to partial satisfaction and overall satisfaction, visitors' propensity to revisit should also be measured. According to Jensen (2004), the motivational factors that influence visitors' decisions to undertake their first visit to a tourism attraction also have a direct impact on their intention to revisit. They are associated with the so-called core of the product, which represents the main experience or key value of the tourism attraction that visitors come to experience. In this context, cave visitor satisfaction was addressed by Ciki et al. (2025) who, using self-determination theory as a conceptual framework, examined the relationships between experiences, motivation, satisfaction and revisit intentions. The relationship between the motivation and satisfaction of cave visitors was also analyzed by Shavanddasht et al. (2017), who considered intrinsic and extrinsic motivations of visitors as effective tools for prediction. In addition to motivational factors, Jensen (2004) also identifies so-called 'hygiene' factors (e.g. hospitality services, souvenir sales) that indirectly influence revisit propensities. Visitors usually do not return because of such factors, but their quality may influence the level of satisfaction with motivational factors (Nowacki, 2013).

3. Methodology

The aim of the paper is to identify objective and subjective satisfaction factors of visitors to selected show caves in Slovakia in the context of their importance, and to investigate their influence on overall satisfaction. The analysis is based on primary data collected by a questionnaire survey between February 2024 and May 2024. The sample of respondents consists of 400 visitors to six caves in Slovakia, namely: Važecká jaskyňa, Dobšinská Ľadová jaskyňa, Jasovská jaskyňa, Harmanecká jaskyňa, Gombasecká jaskyňa and Belianská jaskyňa.

Respondents were recruited on a voluntary basis through a convenience sampling method. It should be noted that data collection occurred outside the peak summer tourist season, therefore, satisfaction levels measured in this study may not fully represent conditions during periods of high tourist levels, when larger visitor groups and greater use of cave infrastructure could affect the visitor experience.

The distribution of respondents across caves did not strictly reflect actual visitor attendance. For example, Belianska jaskyňa, the most frequently visited cave in Slovakia, contributed the smallest share of respondents, while Važecká jaskyňa, with lower overall visitation, contributed the largest share. This uneven distribution should be considered when interpreting results, as satisfaction levels in heavily visited caves may differ from those in less frequented caves.

Based on a content-causal analysis of the reviewed literature, we examine respondents' satisfaction with cave visits in the context of objective factors (cave characteristics, influenced by management) and subjective factors (socio-demographic characteristics of visitors, not influenced by management).

The IPA method and the so-called importance-satisfaction index were applied to analyse objective factors of satisfaction. To calculate the importance-satisfaction indices for the selected factors, we used a modified formula from the case study of the American research and consulting firm, ETC Institute (2010, p. 23), which specializes in market research for local and governmental organizations and identification of the importance-satisfaction indices in the context of the public services of the city of Perryville. The higher the index value, the more attention managers should pay to the factor in management. Calculation of the importance-satisfaction index:

$$i = x\,(1 - y)$$

where: x – proportion of respondents for whom the factor is important (giving it a score of 1 or 2); y – proportion of respondents who are satisfied as a result of the factor (giving it a partial satisfaction score of 1 or 2).

ETC Institute (2010) interprets the index values at three intervals, and the higher the index value, the more attention managers should pay to it. If the index is in the interval from 0 up to 0.1 managers can continue to maintain the attention they have paid to the factor so far. An index in the interval from 0.1 up to 0.2 indicates the need for increased attention, and an index in the

interval from 0.2 to 1.0 warns that, given the possible negative impacts of the factor, managers should greatly increase their attention and take corrective action without delay.

We test the relationship between subjective factors and overall satisfaction using non-parametric tests. The Kruskal-Wallis test, which is used as a non-parametric analogue of simple sorting analysis of variance in cases where the distribution of samples is not normal, will be used to investigate whether there are differences in the importance ratings of selected factors influencing the use of caves in tourism in terms of the age of visitors. At the same time, we will use it to find out whether the age of the visitors has an impact on their partial satisfaction. In more detail, we interpret the effect of age on the importance of each factor according to the values of Spearman's correlation coefficient.

The ranking of the factors under study is constructed by the Friedman and Wilcoxon test. Their impact on overall satisfaction is analysed by logistic regression, which addresses the same basic question as linear regression, namely whether there is a relationship between the independent variables and the dependent variable. However, unlike linear regression, the dependent variable is categorical, i.e. binary, multi-categorical nominal or ordinal (Elliott & Woodward, 2014). Since satisfaction as a dependent variable is measurable on an ordinal scale, it is classified as an ordinal variable and the use of logistic regression is therefore justified. We verify the results at a significance level of $\alpha = 0.1$.

4. Research area

Currently there are more than 8,100 known caves in Slovakia, including shorter caves of an overhanging character. Most of the registered caves are in the Slovak Karst, the Low Tatras and the Spiš-Gemer Karst, Veľká Fatra, and the Western, High and Belianske Tatras. In the territory of the Slovak Republic, caves are usually formed by nature in limestones, less frequently in travertines and occasionally in other less soluble rocks (Štátna ochrana prírody Slovenskej republiky – Správa slovenských jaskýň, n.d.). Moreover, many caves also occur in non-carbonate rocks, formed through other natural processes such as gravity, erosion and weathering (Lenart & Pánek, 2013).

All the caves surveyed for visitor satisfaction are managed by the Slovak Caves Administration and are National Natural Monuments. Gombasecká and Jasovská jaskyňa are situated in the Slovak Karst and have been inscribed on the World Natural Heritage List since 1995. Dobšinská Ľadová jaskyňa was included in this list in 2000 and is located in the Slovak Paradise (Figure 2).

In addition to their geographical location, the studied caves differ in their physical parameters, duration of the guided tour, average internal temperature and unique natural features. These characteristics are important for understanding both the visitor experience and the management requirements of individual caves. A detailed overview of the main characteristics of the surveyed caves is presented in Table 1.

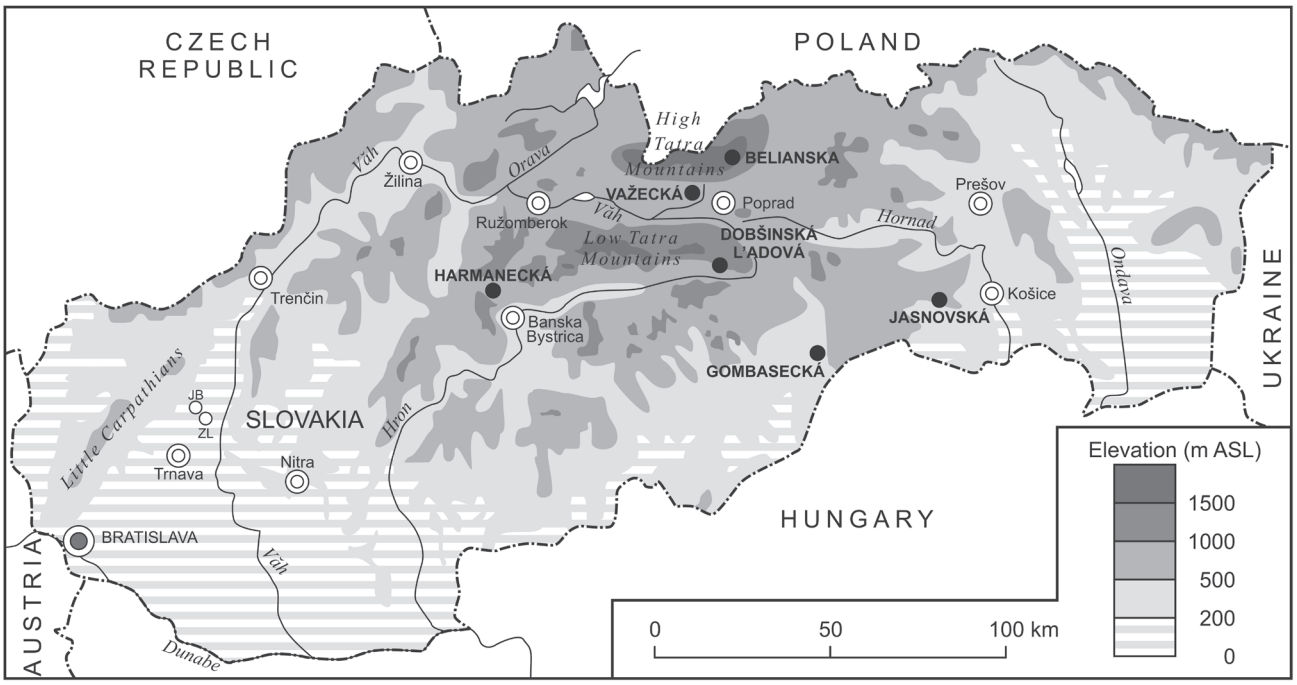

Figure 2. Location of the caves covered
Source: Povinec et al. (2012) elaborated by the authors

Table 1. Basic characteristics of the caves surveyed

Name of the cave	Location	Length of show path (m)	Duration of tour (min)	Average temperature (°C)	Special features
Važecká jaskyňa	Low Tatras	235	25	from 6.5 to 7.1	rich snow-white sinter decoration, small lakes and an important paleontological site of cave bear bones
Dobšinská ľadová jaskyňa	Slovak Paradise	515	30	from –3.9 to –0.2	ice falls, ice stalagmites and columns
Jasovská jaskyňa	Slovak Karst	720	45	from 8.8 to 9.4	rich sinter filling, pagoda-shaped stalagmites, stalagnates, "stone" waterfalls, drums, straws and other forms
Harmanecká jaskyňa	Veľká Fatra	1020	60	from 5.8 to 6.4	white soft sinter, pagoda-shaped stalagmites, wall waterfalls and curtains and sinter lakes
Gombasecká jaskyňa	Slovak Karst	530	30	from 9.0 to 9.4	unique thin sinter straws – thin tubular stalactite formations, which reach a length of up to 3 m
Belianska jaskyňa	Belianske Tatras	1370	70	from 5.0 to 6.3	sinter waterfalls and pagoda-shaped stalagmites

Source: processed according to Štátna ochrana prírody Slovenskej republiky – Správa slovenských jaskýň (n.d.).

Respondents were selected through a convenience sampling method, participating voluntarily based on their willingness. Most (25%) of the respondents were visitors to Važecká jaskyňa (Table 2). In 2024, 15,657 visitors visited the cave. In contrast, the smallest proportion of the sample was made up of respondents who visited Belianska jaskyňa. As of 2017, this cave is the most visited cave in Slovakia with the number of visitors in 2024 reaching almost 120,000 (Štátna ochrana prírody Slovenskej republiky – Správa slovenských jaskýň, n.d.).

Table 2. Sample of visitors to the studied caves

Name of the cave	Number of visitors	Percentage of visitors
Važecká jaskyňa	100	25.00
Dobšinská ľadová jaskyňa	81	20.25
Jasovská jaskyňa	71	17.75
Harmanecká jaskyňa	60	15.00
Gombasecká jaskyňa	49	12.25
Belianska jaskyňa	39	9.75
Total	400	100.00

Source: authors.

5. Results

Almost two thirds of the sample were male. In terms of age, the largest number were younger people aged 18 to 25 years (38.50%) and 26 to 35 years (16.75%). People with a university degree were predominant (51.25%). Most (21.5%) of the respondents were from the Košice region (Table 3).

Table 3. Socio-demographic characteristics of respondents

Socio-demographic characteristics of respondents		Absolute values	Percentage
Gender	Female	143	35.75
	Male	257	64.25
	Total	400	100.00
Age	Up to 18 years	29	7.25
	19–25 years old	154	38.50
	26–35 years old	67	16.75
	36–45 years old	40	10.00
	46–55 years old	41	10.25
	56–65 years old	33	8.25
	66–75 years old	24	6.00
	76 and over	12	3.00
	Total	400	100.00
Highest education completed	Basic	32	8.00
	Secondary	163	40.75
	Higher education	205	51.25
	Total	400	100.00
Residence	Banská Bystrica Region	43	10.75
	Bratislava Region	43	10.75

Residence	Košice region	86	21.50
	Nitra region	68	17.00
	Trenčín Region	56	14.00
	Trnava Region	25	6.25
	Prešov Region	25	6.25
	Žilina Region	46	11.50
	Abroad	8	2.00
	Total	400	100.00
Employment	Student	154	38.50
	Employed	150	37.50
	Self-employed person	2	0.50
	Unemployed	36	9.00
	Maternity leave	20	5.00
	Retired	38	9.50
	Total	400	100.00

Source: authors.

A positive finding is that almost 45% of the respondents visited the caves repeatedly. The majority (70.75%) of the respondents organized their visit individually. Most often (26%) respondents came as families with children, but there was a fairly equal representation of visitors who came accompanied by friends or acquaintances (16.25%), spouse/partner (15.5%) and classmates (15.5%) (Table 4).

Table 4. Other identifying characteristics

Identifying characteristics of respondents		Absolute values	Percentage
Order of visit	First	223	55.75
	Second to third	109	27.25
	More than third	17	17.00
	Total	400	100.00
Method of organizing the visit	Individual	283	70.75
	Organized by a tour operator, school or the other organization	117	29.25
	Total	400	100.00
Visit with	Alone	55	13.75
	Partner	62	15.50
	Family with children	104	26.00
	Other family members	49	12.25
	Classmates	62	15.50
	Friends, acquaintances	65	16.25
Visit with	Friends, acquaintances	65	16.25
	Other	3	0.75
	Total	400	100.00

Source: authors.

The overall level of satisfaction of visitors to the caves is high. Out of 400 respondents, 36% were very satisfied with their cave visit and more than half were satisfied. A neutral position (neither satisfied nor dissatisfied) was taken by only 5.75% of the respondents. Five percent of the respondents left the cave dissatisfied or very dissatisfied (Table 5).

Table 5. Respondents according to the level of satisfaction with the cave visit in %

Satisfaction rate	Percentage of respondents
Very satisfied	36.00
Satisfied	52.25
Neither satisfied nor dissatisfied	5.75
Dissatisfied	3.75
Very dissatisfied	1.25
I don't know	1.00
Total	100.00

Source: authors.

These results are supported by the analysis of complaints during and after the tour route in Figures 3 and 4. The data shows that during the tour route up to 85% of respondents had no reason to complain, 11% had a reason but did not express a complaint and 4% of respondents actively complained during the tour route. This suggests that the majority of visitors did not experience significant problems that affected their experience or required intervention (Figure 3).

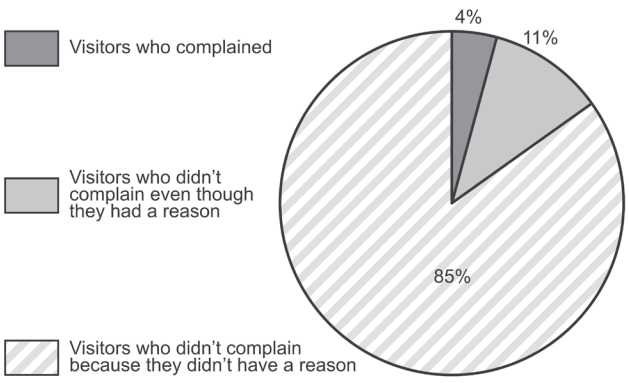

Figure 3. Complaints during a tour
Source: authors

After completing the tour route, 3% of respondents complained. Another 11% did not complain despite having a reason. It is essential to pay special attention to these visitors, as this group is at risk of spreading negative information by word of mouth or electronically and is less likely to revisit (Figure 4).

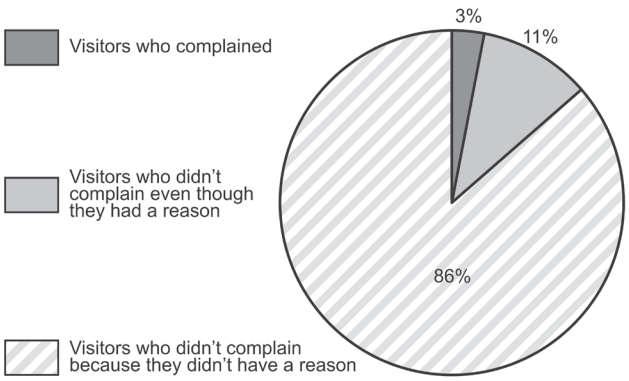

Figure 4. Complaints after the end of the tour route
Source: authors

In the analysis of the factors of satisfaction of the visitors of the selected caves, 14 objective factors and 5 subjective factors are considered separately.

5.1. Objective factors of satisfaction

In relation to visiting the cave, respondents rated satisfaction with:

1. information accessibility,
2. marking at the destination,
3. location and access,
4. parking,
5. neatness of the exterior and entrance areas,
6. price adequacy of entrance fees,
7. possibility of discounts,
8. opening hours,
9. tour route,
10. staff access,
11. quality of the guide's interpretation,
12. number of people in a group during a tour,
13. souvenir shop,
14. toilets.

Respondents also rated selected factors in terms of importance.

For each factor, an average rating of importance and an average rating of sub-satisfaction, which determines overall satisfaction, is determined based on respondents' answers. Figure 5 shows that for parking, reasonableness of admission prices and sanitary facilities, the average importance exceeds the current average satisfaction level, i.e. these are factors that are key for visitors, but there is room for improvement in terms of satisfaction for these services.

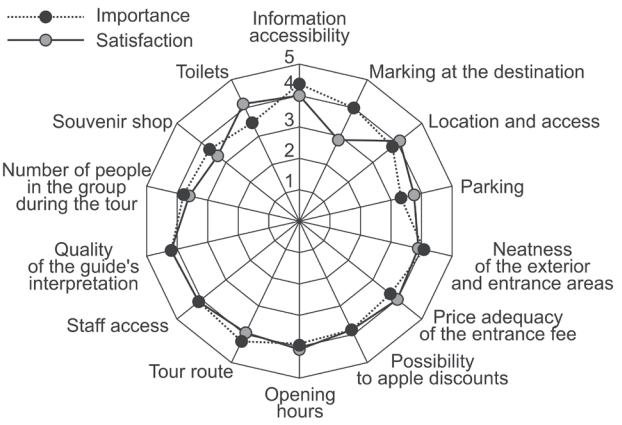

Figure 5. Satisfaction factors of visitors to the studied caves in the context of importance
Note: importance level (5 – *absolutely important*, 1 – *absolutely unimportant*); satisfaction level (5 – *very satisfied*, 1 – *very dissatisfied*)
Source: authors

Figure 6. Importance-performance analysis (IPA) – scheme of visitor satisfaction and importance factors in the examined caves
Note: 1 – information accessibility, 2 – marking at the destination, 3 – location and access, 4 – parking, 5 – neatness of the exterior and entrance areas, 6 – price adequacy of the entrance fee, 7 – possibility of discounts (disabled, student, pensioner), 8 – opening hours, 9 – tour route, 10 – staff access, 11 – quality of the guide's interpretation, 12 – number of people in a group during a tour, 13 – souvenir shop, 14 – toilets. Importance level: 5 – *absolutely important*, 1 – *absolutely unimportant*; satisfaction level: 5 – *very satisfied*, 1 – *very dissatisfied*
Source: authors

The result of the analysis of the average importance rating and the partial satisfaction ratings is a matrix that allows the rated factors to be classified as strategic disadvantages, strategic advantages, acceptable

disadvantages or irrelevant advantages. The average rating of the factors shows that, except for signage at the destination, all factors selected based on the literature are more than moderately important to the visitors. Although most of the factors fall within the strategic advantages of the caves, it is essential to draw attention to their location in the quadrant. However, the closest to strategic disadvantages are parking and toilets (Figure 6).

Based on the methodology of the American ETC Institute (2010), importance-satisfaction indices were calculated for selected factors affecting visitor satisfaction. The results suggest that managers should monitor all objective factors, even those classified as strategic advantages in the IPA matrix. While parking emerges as the top priority and marking at the destination ranks slightly lower in the matrix, the indices show that both factors have almost identical values (0.291 and 0.290), indicating comparable significance. Additionally, the larger gap between 0.290 and 0.215 compared to 0.215 and 0.195 highlights the need to consider the precise position of each value within its interval when evaluating the urgency of management interventions (Table 6).

Table 6. Objective satisfaction factors according to the importance-satisfaction index

Factors	Index of importance-satisfaction	Recommendation
Parking	0.291	Immediate attention required
Marking at the destination	0.290	Immediate attention required
Price adequacy of entrance fees	0.215	Immediate attention required
Souvenir shop	0.195	Increase attention
Information accessibility	0.193	Increase attention
Opening hours	0.182	Increase attention
Number of people in a group during a tour	0.182	Increase attention
Possibility of discounts	0.170	Increase attention
Location and access	0.161	Increase attention
Staff access	0.154	Increase attention
Quality of the guide's interpretation	0.149	Increase attention
Toilets	0.146	Increase attention
Neatness of exterior and entrance areas	0.123	Increase attention
Tour route	0.109	Increase attention

Source: authors.

The order of importance of the factors is constructed using a Friedman and Wilcoxon test. The results of the analysis clearly identified the quality of the guide's interpretation as the most important factor from the perspective of the respondents, underlining the importance of expert and engaging information delivery when visiting tourist sites. Most (95.75%) of the respondents were guided in Slovak, 3% in English and the remaining (1.25%) in German, Polish or Hungarian.

Access to staff ranked second, reflecting the key role of interpersonal communication and the professional behaviour of staff in the tourism industry. The least important factors are the number of people in a group during a tour, the service of souvenir shops and signage at the destination. This finding is important for setting priorities in management, where increased attention should be paid especially to human capital development and the quality of content communication (Table 7).

Table 7. Ranking of objective factors in terms of importance

Factors	Friedman test (average ranking)	Wilcoxon test	
		order	*p*-value
Quality of the guide's interpretation	6.14	1.	–
Staff access	6.55	2.	0.008
Toilets	6.57	3.	0.876
Operating hours	6.91	3.	0.487
Information accessibility	6.93	3.	0.966
Location and access	6.96	3.	0.997
Price adequacy of entrance fees	6.99	3.	0.688
Tour route	7.04	3.	0.276
Neatness of exterior and entrance areas	7.21	3.	0.668
Possibility of discounts	7.47	4.	0.050
Parking	7.82	4.	0.514
Number of people in a group during a tour	8.70	5.	0.000
Souvenir shop	9.46	5.	0.000
Marking at the destination	10.27	5.	0.000

Source: authors.

There are less significant differences in the ranking of factors in terms of visitors' partial satisfaction than in the ranking of factors in terms of importance. Respondents expressed the highest satisfaction with information accessibility, the tour route, the quality

of interpretation, the neatness of the exterior and entrance areas, the attitude of the staff, and marking at the destination. The results also indicate a need for improvement, particularly in additional services and infrastructure, in which respondents were most satisfied (Table 8).

Table 8. Ranking of objective factors in terms of satisfaction

Factors	Friedman test (average ranking)	Wilcoxon test	
		order	*p*-value
Information accessibility	6.15	1.	–
Sightseeing route	6.38	1.	0.153
Quality of the guide's interpretation	6.38	1.	0.583
Neatness of exterior and entrance areas	6.65	1.	0.544
Staff access	6.82	1.	0.232
Marking at the destination	7.14	1.	0.479
Location and access	7.37	2.	0.012
Possibility of discounts	7.42	2.	0.876
Opening hours	7.61	2.	0.530
Number of people in a group during a tour	7.94	2.	0.127
Price adequacy of entrance fees	8.03	2.	0.454
Souvenir shop	8.79	3.	0.002
Toilets	9.08	4.	0.037
Parking	9.26	4.	0.971

Source: authors.

Ordinal logistic regression examines the impact of individual factors on overall visitor satisfaction. The obtained *p*-values, lower than the chosen significance level, confirm that the number of people in a group during a tour, the tour route, the neatness of the exterior and entrance areas, location and access, the services of the gift shops, the quality of the guide's interpretation and parking have a statistically significant effect on overall visitor satisfaction. The statistically significant influence of other factors was not confirmed by *p*-values greater than the chosen significance level. That is, visitors' partial non-satisfaction with admission price, staff access, information availability, signage to the attraction at the destination, restrooms, ability to redeem discounts, and hours of operation did not significantly affect their overall satisfaction rating for their visit to the cave (Table 9).

Table 9. Effect of objective factors on overall satisfaction of cave visitors (expressed by ordinal logistic regression)

Factors	*p*-value
Number of people in a group during a tour	0.002
Tour route	0.023
Neatness of exterior and entrance areas	0.053
Location and access	0.074
Souvenir shop	0.079
Quality of the guide's interpretation	0.092
Parking	0.096
Price adequacy of entrance fees	0.343
Staff access	0.418
Information accessibility	0.491
Marking at the destination	0.614
Toilets	0.615
Possibility of discounts	0.638
Opening hours	0.959

Source: authors.

5.2. Subjective factors of satisfaction

Among the subjective factors we pay attention to the gender, age and education of visitors, the method of organization and the number of visits. The results of the Mann-Whitney test (p-value > α) do not indicate differences in visitor satisfaction by gender. Based on the mean scores, we conclude that men and women are approximately equally satisfied with their visit to the studied caves (Table 10).

Table 10. Relationship between satisfaction rate and gender of visitors (Mann-Whitney test)

Gender	Average score	*p*-value
Male	202.94	0.726
Female	199.14	

Source: authors.

The *p*-values found by correlation analysis confirm the dependence between satisfaction rate, age and education of visitors. Meanwhile, the negative values of Spearman's correlation coefficient indicate that the satisfaction of cave visitors increases with greater age and higher education (Table 11).

The *p*-values found by the Kruskal-Wallis test further confirm that there are age differences in the importance

ratings of information availability, the ability to redeem discounts, and hours of operation. Meanwhile, the positive value of the Spearman correlation coefficient indicates that the older the visitors are, the less important the factor is to them. This implies that younger visitors attach more importance to information availability, the possibility of discounts and operating hours than older respondents. The importance of other objective factors is not influenced by age (Table 12).

Table 11. Relationship between satisfaction rate, age and education of visitors

Socio-demographic characteristics	Spearman's correlation coefficient	*p*-value
Age	–0.102	0.041
Education	–0.091	0.068

Source: authors.

Table 12. Influence of age on the rating of importance of factors

Factors	Kruskal-Wallis test (*p*-value)	Spearman's correlation coefficient	*p*-value
Information accessibility	0.001	0.126	0.012
Possibility of discounts	0.038	0.118	0.018
Opening hours	0.039	0.100	0.046

Source: authors.

Differences in cave visitor satisfaction are also indicated by the Mann-Whitney test according to method of organising the visit. The results show that visitors coming to the caves individually are more satisfied than members of organised groups. This fact is related to the composition of organized groups, which are mainly pupils and students, often without real interest in the exhibits presented (Table 13).

Table 13. Relationship between satisfaction rate and the way visits are organised (Mann-Whitney test)

Method of organising the visit	Average score	*p*-value
Individual	190.95	0.004
Organized	223.60	

Source: authors.

The correlation analysis did not show a statistically significant relationship between the satisfaction rate and the number of visits, suggesting that the subjective satisfaction rating is not influenced by whether the visitor visited the cave for the first time or repeatedly. This may be due to the consistency of the services provided, but also to variability in individual expectations and experiences (Table 14).

Table 14. Relationship between visitor satisfaction rate and visit ranking

Identification characteristic	Spearman's correlation coefficient	*p*-value
Number of visits	–0.029	0.557

Source: authors.

We also identify the influence of individual subjective factors by ordinal logistic regression. The observed *p*-values demonstrate that the subjective factors that have a statistically significant effect on overall visitor satisfaction include only the way in which the visit is organized. Although Spearman's correlation coefficient indicated a statistically significant relationship between age, education and overall satisfaction, the ordinal logistic regression results did not support this relationship. The difference may be attributed to methodological approaches. While correlation reveals even weak monotonic trends, regression operates with a probabilistic model and may treat a weak relationship as irrelevant when strictly testing for statistical significance. Thus, age and education can be identified as weakly related but not critical variables in predicting visitor satisfaction (Table 15).

Table 15. Effect of subjective factors on overall satisfaction of cave visitors (ordinal logistic regression)

Factors	*p*-value
Method of organising the visit	0.008
Age	0.100
Education	0.253
Gender	0.496
Number of visit	0.791

Source: authors.

High satisfaction is the main prerequisite for loyal visitor behaviour. This is confirmed by the moderately strong correlation between the level of satisfaction of respondents and their intention to visit the cave again in the future (Table 15). Fifty-three percent of respondents would return to a cave based on their previous experience of respondents would return to a cave based on their previous experience.

Visitor satisfaction is not only related to repeat visits, but also to spreading the reputation of the cave. Based on their own experience, almost 8% of respondents would not recommend a visit to the cave to friends. It can be expected that these visitors also become

spreaders of a cave's bad reputation. A correlation analysis confirmed the existence of a direct moderate correlation between the level of satisfaction of visitors and their willingness to recommend a visit to a cave to friends (Table 16).

Table 16. Relationship between satisfaction rate and loyal visitor behaviour

Variable under study	Spearman's correlation coefficient	*p*-value
Future cave visit	0.308	0.000
Recommending a cave to friends	0.314	0.000

Source: authors

6. Discussion

Through the demand survey, we observed some common and different characteristics of the respondents compared to the typical profile of a visitor in caving tourism or geotourism in general, as presented in international studies. In terms of age, respondents under 35 years of age were the most represented. The findings of European surveys (Antić, 2018; Marjanović et al., 2023) confirm that caves as tourism attractions are nowadays mainly visited by 16–35 year olds. According to gender, almost two-thirds of our sample were men; according to the results of other surveys (Jasso Barron, 2024; Vasiljević et al., 2018), women travel more often for geotourism attractions. In terms of educational attainment, those university educated were the most represented in the sample; as for the results of other studies (Antić, 2018; Marjanović et al., 2023), visitors with higher education visit caves more often. In line with the results of Tessema et al. (2022), geotourists travel mainly in groups of families with children or friends. The proportion of visitors who organized their visit to the cave individually (about 70%) corresponds to the results of the study by Shavanddasht et al. (2017) who analyzed the motivation and satisfaction level of visitors to Alisadr cave in Iran.

Of the total number of respondents, 5% were dissatisfied with their visit to the cave. In terms of exploring visitor satisfaction with caves, we took the same approach as Nowacki (2013), who looked at visitor satisfaction with cultural attractions, and focused specifically on objective and subjective factors. In contrast, some authors (e.g. Mitríková & Baranova, 2018) have investigated cave visitor satisfaction factors without distinguishing their nature. Moreover, following the model of De Nisco et al. (2015) and Deng and Pierskalla (2018), we also examined objective factors in the context of their importance to visitors. In doing so, we came to the conclusion that the quality of the guide's interpretation and, consequently, the attitude of the staff, is the most important for visitors to the caves examined in Slovakia. Also in the study of Antić, Vujičić et al. (2022), the respondents from Serbia rated guide services as the most important. Within the category of least important factors, variables related to organisational and infrastructural aspects of the destination are found in both surveys. The study by Antić, Vujičić et al. (2022) identified the number of organised visits, the number of visitors and the proximity to tourist centres, as the least important factors. According to the results of our survey, the least important factors according to visitors are the size of a group during a tour, the presence of souvenir shops and the quality of signage at the destination, which shows consistency of results across different geographical contexts.

We identified the influence of objective and subjective factors on cave visitor satisfaction using ordinal logistic regression. We concluded that among the objective factors, selected on the basis of a content-causal analysis of the current literature, the number of people in a group during a tour, the tour route, the neatness of the exterior and entrance areas, location and access to the cave, services of the gift shops, the quality of the guide's interpretation and parking have a statistically significant influence on the overall satisfaction of cave visitors in Slovakia. Results from Jasso Barron and Xu's (2024) survey of visitor satisfaction at three selected caves in the state of Missouri indicated that age, motivation and sensory experience were key factors associated with overall visitor satisfaction with caving tourism. Although the findings of this research on the influence of factors on cave visitor satisfaction are interesting, multiple linear regression was used to examine the regression of categorical variables. Based on the theory that satisfaction is measurable on an ordinal scale, which classifies it as a categorical variable, the available literature (e.g. Gambarota & Altoè, 2024; Rimarčík, 2007; Winship & Mare, 1984) suggests that logistic regression is appropriate to examine regression with binary, multi-categorical nominal and ordinal variables being explained.

We first examined the relationship between subjective factors and visitor satisfaction using non-parametric tests. We concluded that, in general, older and more educated people who organise their visit individually are more satisfied with their visit to the cave. This is in line with Nowacki (2013) who argues that younger and less educated visitors are more satisfied with tourism attractions offering mainly entertainment and diversion, and conversely, older and more educated visitors are more satisfied with attractions offering mainly educational and cognitive functions.

Younger respondents attach more importance to the availability of information, the possibility of

taking advantage of discounts and opening hours than older respondents. These findings have practical implications for the segmentation and targeting of cave tourism marketing communications. Focusing on the availability of relevant information, discount programs and flexibility of operation may be more effective, particularly with the younger visitor segment, which perceives these factors as critical in planning a visit. For older visitors, it is more appropriate to emphasize other aspects of services that appeal to them, regardless of hours of operation or price advantages.

In spite of the demonstrated relationships, based on the results of ordinal logistic regression, only the method of organization of a cave visit can be considered as a significant subjective factor of satisfaction for the visitors of the studied caves in Slovakia.

Based on these findings, practical recommendations can be proposed for cave managers to improve visitor satisfaction and optimize the operation of natural tourist attractions. The quality of a guide's interpretation should be regularly monitored, and guides should participate in training focused on interactive and educational elements tailored to different visitor groups. Orientation and signage within the cave area should be clear, understandable and consistent, including safety instructions and information panels explaining geological and historical aspects. Group sizes should be limited or visits divided into time slots to prevent overcrowding and reduce negative experiences from long waits or restricted space. The tour route and duration should be adapted to the abilities and expectations of different visitor groups, including families with children or school groups to maximize enjoyment and minimize fatigue. Pricing policies and discounts can be flexible, e.g., for students, families, or repeat visitors, which increases the likelihood of revisits. This approach to visitor segmentation and service adaptation is supported by Tessema et al. (2022), who emphasize the importance of tailoring tourism products to different market segments to improve overall experience and support sustainable geotourism development.

It is also important to note several limitations of this study. First, respondents were selected using a convenience sampling method, which may not fully represent the entire population of cave visitors in Slovakia. Second, only six caves were included, limiting the generalizability of the results. In addition, the research was conducted outside the peak tourist season, and therefore the distribution of respondents does not fully reflect the actual popularity of the caves included in the study. Seasonal factors, individual cave characteristics, and variations in visitor profiles may also influence satisfaction outcomes. These limitations should be taken into account when interpreting the results and drawing conclusions.

7. Conclusion

A comprehensive analysis of objective and subjective factors of visitor satisfaction in selected Slovak caves has shown that although the overall level is relatively high there are several areas that require strategic attention. The findings highlight the priority role of quality guided interpretation and staff approach in shaping a positive visitor experience. At the same time, the need to improve infrastructure and ancillary services was confirmed, particularly in relation to parking and sanitation, the lack of which can negatively affect overall satisfaction.

The results of the ordinal logistic regression also highlighted the influence of the number of people in a group, the quality of the tour route, the neatness of the environment, the accessibility of the site, the offer of souvenirs and parking, on overall satisfaction. In terms of subjective factors, the way the visit was organised emerged as a significant determinant, with individual visitors showing higher levels of satisfaction compared to organised groups.

In the context of identified differences in preferences and satisfaction from various visitor segments, especially with regard to age and the way the visit is organised, it seems necessary to implement a more differentiated and targeted marketing approach. Focusing on improving key objective factors with lower satisfaction rates and high importance, together with strengthening the quality of guiding services and adapting the offer to the specific needs of different target groups, is the way to optimally exploit the potential of Slovak caves in domestic and international tourism.

Therefore, an integral part of sustainable and competitive operation of the caves in the tourism market should be continuous monitoring of satisfaction, including early capture of dissatisfied visitors by implementing various forms of support for expressing complaints, negating the most frequently identified causes of dissatisfaction and actively responding to visitors' suggestions.

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