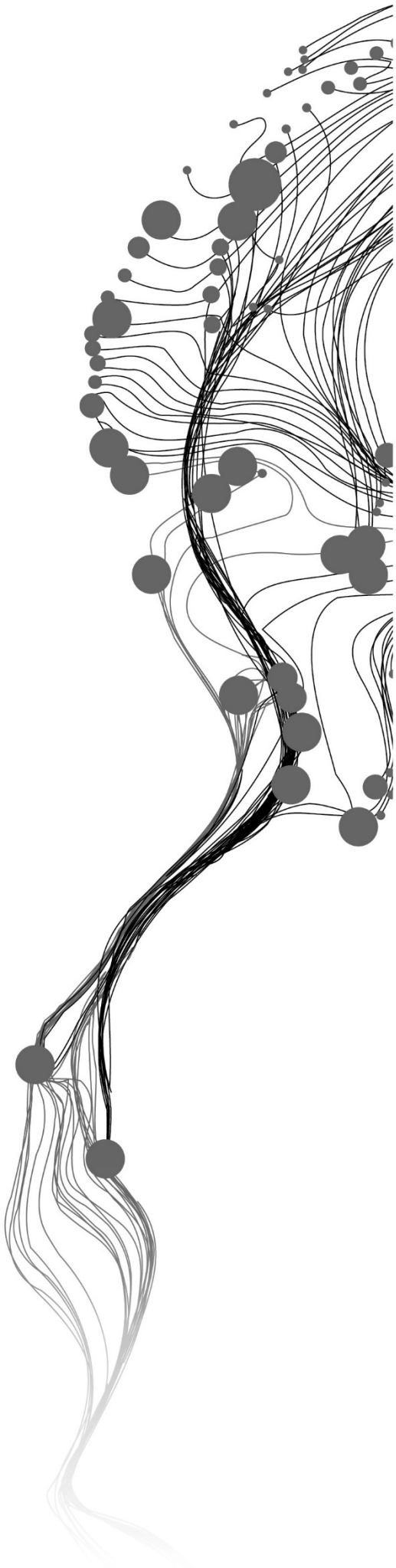

An Empiric Evaluation of the Affordances of Panorama Maps and Planimetric Maps in the Context of Alpine Ski Areas

The Example of SkiWelt Wilder Kaiser - Brixental

JENNY JANSSEN
Enschede, The Netherlands, September, 2020

Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation.
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Jenny Janssen

2020

Statement of Authorship

Herewith I declare that I am the sole author of the submitted Master's thesis entitled:

"An Empiric Evaluation of the Affordances of Panorama Maps and Planimetric Maps in the Context of Alpine Ski Areas: The Example of SkiWelt Wilder Kaiser - Brixental".

I have fully referenced the ideas and work of others, whether published or unpublished.
Literal or analogous citations are clearly marked as such.

Abstract

Many people across the world enjoy alpine winter sports. Since the advent of modern winter sports, in particular alpine skiing, ski areas have been depicted cartographically for the purposes of marketing and to provide an overview of the slopes and lift infrastructures available. The panorama map, considered the de facto standard for alpine winter sport areas, is ubiquitous throughout most ski areas and used to entice prospective visitors and to accompany them once on the slopes.

Personal experience with panoramic ski maps and previous studies focusing on their usability including Balzarini et al. (2015) and Balzarini and Murat (2016) have led the author to explore alternative ways of depicting ski areas. The result is a planimetric ski map created by the author which, alongside a panorama ski map of the same geographical area, is the subject of the research for this thesis. This thesis aims to provide a better understanding of the affordances of the two map styles within the context of wayfinding, spatial cognition, emotional response and user needs by evaluating two depictions of one ski area and comparing how each performs in a user evaluation.

The core of the primary research for this thesis consists of an online-survey through which two random sample groups evaluate either the panorama map or planimetric map of the SkiWelt Wilder Kaiser - Brixental, one of the largest ski areas in Austria. The questions and tasks contained in the survey correspond to the research objectives and research questions pertaining to the affordances of both maps within the context of assisting with wayfinding tasks, imparting geographic comprehension and eliciting emotional reaction and questions related to user needs.

The results from the user evaluation do not suggest that one map is more successful overall than the other. Instead, the user evaluation shows that each map presents users with unique advantages and challenges when used to assist in completing navigation and orientation tasks, highlighting potential areas for improvement as well as features of one map that perform well and which the other could seek to incorporate.

Acknowledgements

I would like to thank my supervisor Franz-Benjamin Mocnik for his help, guidance and insights throughout the process of writing this thesis. I further express my gratitude to the thesis assessment board for their feedback and advice.

I would also like to extend my gratitude to Stefan Grafl of SkiWelt Wilder Kaiser - Brixental Marketing GmbH who kindly supplied me with the official map of the SkiWelt and completed the expert questionnaire. Special thanks also go to Nicola Moczek for her support.

A big Thank you! to everyone who participated in the survey. I hope it was a bit fun, even if alpine winter sport is not one of your preferred activities.

Finally, I express my deepest gratitude to my husband for his unparalleled support and encouragement throughout this semester and this academic adventure as a whole. I am also incredibly grateful to my family who always support me and my decisions throughout my life.

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1. Introduction

1.1 Research context

The combined length of ski slopes currently established across the world amounts to approximately 60,000 km; nearly 1.5 times the circumference of the Earth. Alpine winter sport enthusiasts can choose from some 5,767 ski resorts, 1,136 of which are located throughout the European Alps and offer 26,726 kilometres of slopes accessible by 8,018 lifts (Skiresort Service International, 2020)[1]. Despite the challenges facing the winter tourism industry, among them climate change and changing demographics (Bausch and Gartner, 2020; and Dambeck and Stotz, 2017), it remains an important contributor to the economies of countries such as Austria where in 2010 it was "estimated to generate €7.4 billion [...] representing 3.2% of the country's GDP" (Arbesser, Grohall, Helmenstein and Kleissner, 2010 in Steiger and Abegg, 2013).

Since the advent of modern winter sports, in particular alpine skiing, ski areas have been depicted cartographically for the purposes of marketing and to provide an overview of the slopes and lift infrastructures available. As will be shown by reviewing ski maps throughout the ages in *2. Related Work*, panoramic depictions in one form or another have always been the prevailing map style. Today the panorama ski map is ubiquitous throughout most ski areas around the world, used to entice prospective visitors and to accompany them once on the slopes. In conjunction with wayfinding elements such as fingerposts and slope markers the panorama map forms an integral part of a ski area's suite of information elements (Figure 1.1). The elaborate, often hand-painted panorama overlaid with slopes, lifts and amenities is available as free print maps to be stuffed away in ski jackets and mulled over during breaks (Figure 1.2), mounted on large static display boards at key locations throughout the area, viewable as interactive digital map with real-time information such as lift and piste closures and as PDF files for download.

Patterson (2000) suggests that panorama maps are the de facto cartographic standard for depicting ski resorts. Browsing the many ski maps found on Skimaps.org[2] supports this conclusion. Indeed, a systematic review of North American ski maps by Alex Tait (2012) found that "panoramic views dominate ski trail maps [and] comprise 86% of all maps and 100% of maps for the top 100 resorts". Tait's review further found that planimetric maps made up only 6% of all maps.

The panorama undoubtedly has its place in the suite of information and marketing elements that a ski area may employ to visualise and inform about the destination. Its unique ability to draw the reader in and let them feel as though "they were flying high above the land" (Patterson, 2000) lends itself to showcasing a mountainous ski resort and enabling the prospective skier to imagine how they might "fly" down the slopes. However, while the panorama map evokes strong emotional reactions, it may be argued that this map type is less suitable for efficiently navigating through a ski area as well as orienting oneself due to the way it tends to be distorted and visually skewed to elevate certain topographical features over others. As Tait (2012) states, wayfinding is only one of many drivers when creating a map of a ski area and "can be minor compared to the need for the map to market the ski area and entice new skiers to visit".

It can therefore be inferred that the depiction of routes as lifts and slopes and the points where they intersect – nodes – are not drawn primarily with their ability to aid wayfinding in mind, but follow the topography as it has been painted by the panorama artist who in turn responded to the demands of the map issuer who seeks to present their ski area as being as vast, mountainous and varied as possible.

[1] https://www.skiresort.info

[2] https://skimap.org

Figure 1.1: Wayfinding elements found in the SkiWelt Wilder Kaiser - Brixental.
Source: Janssen (2019)

Figure 1.2: Skiers using a printed ski map on their break (left) and different printed ski map formats (right).
Sources: lucky business/Adobe Stock (left) and Janssen (2019) (right)

To summarise, the problem that inspires this thesis research is the fact that despite some demonstrable shortcomings as wayfinding aides, panoramic depictions of ski areas remain the dominant method of visually communicating winter sport infrastructure. However, a planimetric map may improve the skiers' ability to complete wayfinding tasks. Thus, this thesis looks to compare panoramic and planimetric depictions of an alpine ski area and compares their usability in order to draw conclusions on how each map type performs and whether the results can inform further research into the synthesis of the two map types.

1.2 Research objectives and questions

Personal experience with panoramic ski maps and previous studies focusing on their usability (Balzarini et al. 2015 and Balzarini and Murat 2016) have led the author to explore alternative ways of depicting ski areas. The result is a planimetric ski map created by the author which, along with a panorama ski map of the same geographical area, is the subject of the research for this thesis. By evaluating two depictions of one ski area this thesis aims to provide a better understanding of the affordances of the two map styles within the context of wayfinding, spatial cognition, emotional response and user needs. The following research objectives have been identified:

RO1 Comparing panoramic and planimetric ski maps in terms of their wayfinding, spatial cognition and emotional affordances.

RO2 Identifying the affordances required of a map depicting a ski area from the perspective of the user.

RO3 Making suggestions for further research based on the findings of this study on how panoramic and planimetric maps could be improved and potentially synthesised.

1.3 Research questions

The following research questions are posed in order to answer RO1 and RO2:

RQ1.1 How do the affordances of panoramic and planimetric maps of alpine ski areas differ in terms of their ability to help carry out wayfinding tasks?

RQ1.2 How do the affordances of panoramic and planimetric maps of alpine ski areas differ in terms of helping the user gain a geographic understanding?

RQ1.3 How do emotional responses to panoramic and planimetric maps of alpine ski areas differ?

RQ2.1 Which aspects and qualities of a map are important to users in order to carry out wayfinding tasks in an alpine ski area?

RQ2.2 Which aspects and qualities of a map are important to readers in order to understand the geography of an alpine ski area?

RO3 will be addressed through the outcomes of the research directly related to the preceding objectives and questions.

1.4 Research scope

The research scope for this thesis is not only defined by the aforementioned research objectives and questions but also limited by external circumstances. Several external factors have an impact on the research design scope including the time of year during which the study is conducted and the ongoing global COVID-19 pandemic. The evaluation of maps by users should ideally take place in situ, meaning in the environment that the specific map is intended for. In the case of ski maps, the ideal research location and time would be an alpine ski area during the active winter ski season Figure 1.3). Due to the thesis semester taking place during the spring and summer months this is unfortunately not possible. Furthermore, initial plans to employ person-to-person methods such as eye-tracking, participant observation or thinking aloud were abandoned due to the pandemic and the associated limitations on gatherings and personal contact. As a result the primary research for this thesis took place remotely and is based on an online survey as the core method of generating user evaluation results.

Figure 1.3: Trying out the author's planimetric map in situ at SkiWelt Wilder Kaiser - Brixental.
Source: Janssen (2019)

The types of maps evaluated as part of this thesis is limited to a panoramic (Appendix 1) and planimetric (Appendix 2) depiction of a ski area. Both maps will be static in nature and distributed digitally as part of the online survey (Appendices 3 and 4). The study will look at an Austrian ski area in particular. The primary research will be conducted based on maps depicting SkiWelt Wilder Kaiser - Brixental[3] in Tyrol, Austria. This means that this study will, more broadly, apply to ski areas located in the European Alps. Due to the distinct differences in styles between ski panoramas from North America and those from European alpine countries, this is an important focus to mention. Furthermore, this study focuses on areas that primarily cater to downhill skiing which requires man-made lift and slope infrastructure. Thus, this study does not look at maps made for Nordic-skiing areas as the terrain of these areas and the maps themselves differ vastly from those for alpine skiing.

[3] https://www.skiwelt.at/de/skiwelt-wilder-kaiser-brixental-skigebiet-kitzbueheler-alpen.html

2. Related work

The subject of winter sport cartography and the research objectives and questions of this thesis are related to a broad spectrum of fields of research and areas of interest including cartographic design, usability of maps, spatial cognition and wayfinding, as well as marketing and the perception of place. Before examining these subject areas in detail this chapter opens with a brief introduction to the history of alpine winter sports and skiing in particular. This will provide an overview of the factors that contributed to skiing becoming one of the most popular winter leisure activities across the globe and how this development influenced the cartographic depiction of alpine winter sport areas. This prelude is then followed by sub-chapters about visualising ski areas, usability of ski panoramas and terrain maps, spatial cognition and wayfinding with maps, and the perception of place in relation to cartography and marketing.

2.1 A brief history of skiing

Skiing as a mode of transport has existed for millennia. Prehistoric finds in Russia suggest that it dates back as far as 8000 to 7000 BCE (Burov, 1989 cited in Burov, 2008). However, it was not until the nineteenth century that skiing began its rapid development to become a winter leisure activity attracting as many as 400 million visitors worldwide in 2016 (Tostevin, 2018). Following the Norwegians who began undertaking skiing as a pursuit of leisure in the mid-eighteen hundreds, “socially elite skiers” started spending their winters skiing in the Alps from the end of the nineteenth century (Denning, 2015). However, despite a growing popularity amongst a certain class of the population, skiing remained a niche sport associated with heroism, adventure and the remote outdoors. Denning (2014) likens it to “an act of exploration with its roots in Fridjof Nansen’s Greenland traverse”.

With the introduction of cable cars during the interwar period, however, some of the exhausting and potentially dangerous aspects of skiing began to become a thing of the past. Man-made winter sport infrastructure such as lifts and prepared slopes assigned with various difficulty levels “suggested that Alpine skiing was [now] a sport for all ages and ranges of experience” (Denning, 2014). Denning further explains that with the introduction of lifts the Alpine environment was “engineered for speed, ease of access, and safety”, thus increasing its appeal to a broader audience.

The period between the two world wars also saw the construction of the first purpose-built ski resort. Designed from the ground up to cater to the skiers’ every need, Sestriere in northwestern Italy “transformed an uninhabited snow desert into a ski paradise” (Denning, 2015). This new and radical approach informed much of the design and organisation of other Alpine winter sport destinations, particularly those in France but also in Switzerland and Austria, where skiing facilities had tended to grow more organically. The model of Sestriere was and still is largely characterised by the streamlining of all the aspects and activities involved with recreational alpine skiing, from the journey to the ski area to the time spent on and off the slopes. In the case of Sestriere not only was a new extension to the autostrada built leading directly to the resort, but all services at the destination were managed through a centralised ownership model. A panorama of the resort from 1964 (Figure 2.1) conveys the purpose-built nature of Sestriere and its designation as a place intended solely for the pursuit of winter sports. The view of the landscape, considered by some contemporaries to be “barren” (Denning, 2014), is focused on monolithic man-made buildings and cable cars.

After World War II socio-economic developments and technological advancements dramatically accelerated the transformation of skiing into the winter holiday activity of the masses as we know it

today. Krippendorf et al. (1987, cited in Gyr 2010) points to a range of factors which helped the incredible boom of tourism in the post-war era "including rising affluence, urbanisation, the unprecedented construction of transportation and communication networks, and the increase in leisure time as a result of shorter working hours". For Alpine ski destinations however, the invention of the snow-canon in the 1950 was transformative in enabling them to mitigate "nature's deficiencies [...] through human ingenuity" (Pröbstl, 2006 cited in Denning, 2014) and offer increased certainty of good snow conditions to holiday makers within an increasingly crowded market (Denning 2014). By the 1960s skiing was firmly established as a leisure pursuit as well as a competitive sport followed by millions on television. Skiing featured in film, James Bond being seen speeding downhill in *On Her Majesty's Secret Service*, it was featured in tobacco advertisements, and real-world ski athletes such as Jean-Claude Killy who, following his triple gold medal win at the 1968 Grenoble Winter Olympics, rose to become a "global icon" and "celebrity endorser" for brands like Chevrolet (Denning, 2014). Skiing had finally become main-stream as concluded by Hunter S. Thompson in his book *The Great Shark Hunt* (1979):

> *"Skiing is no longer an esoteric sport for the idle rich, but a fantastically popular new winter status-game for anyone who can afford $500 for equipment. Five years ago the figure would have been three times that, plus another loose $1000 for a week at Stowe or Sun Valley, but now, with the advent of snow-making machines, even Chattanooga is a 'ski-town'."*

With alpine winter sports being such a popular outdoor activity, maps and other cartographic products in a wider sense that visualise alpine winter sport areas can be considered an important and deserving of closer attention.

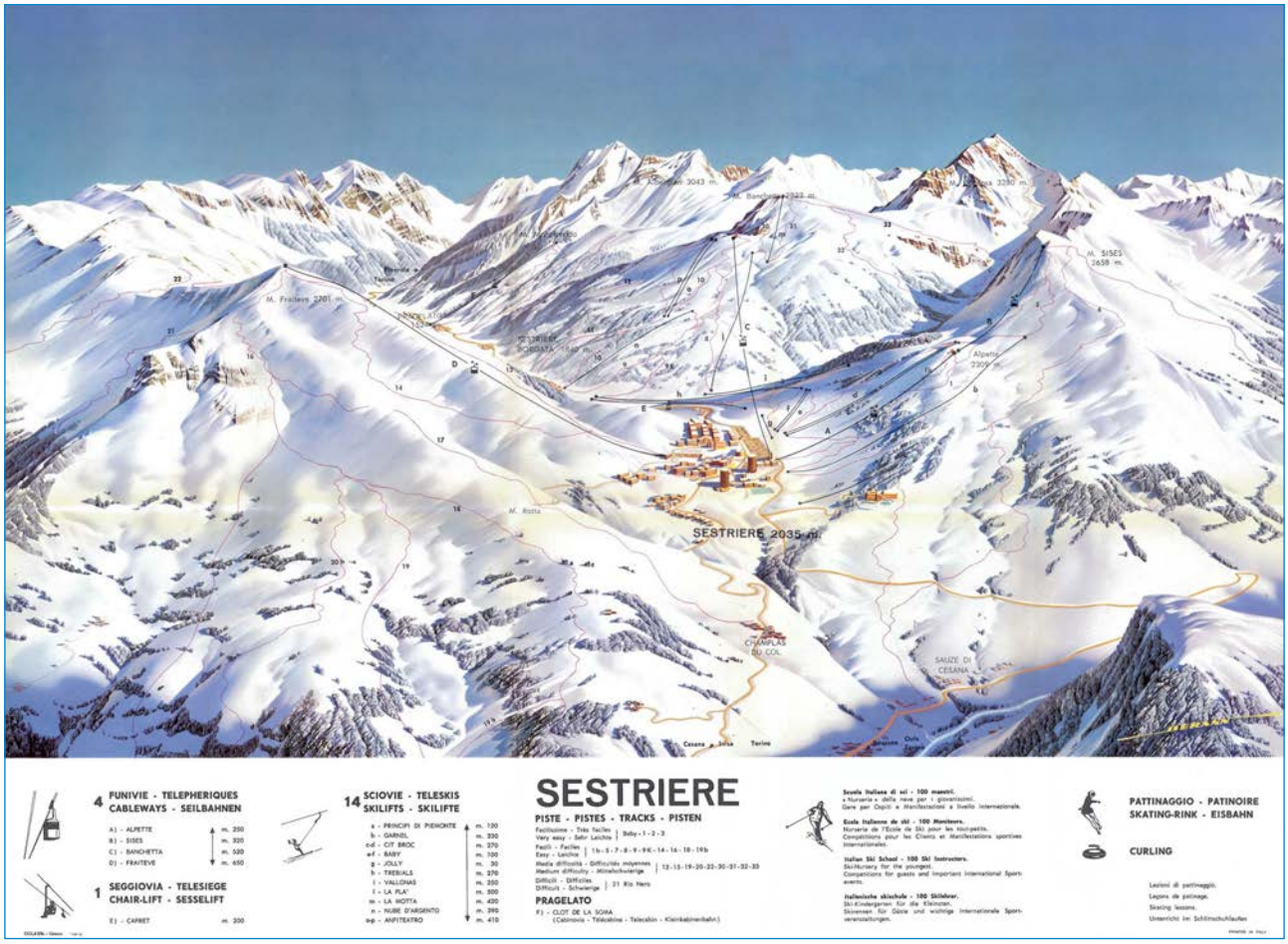

Figure 2.1: Panorama of Sestriere from 1964 showing the 1930's purpose-built resort at the centre.
Source: skimap.org (CC BY-NC-SA 3.0 license)

2.2 Visualising ski areas

As skiing began to be become safer and more accessible following the introduction of cable cars in the 1930s winter sport destinations on both sides of the Atlantic started to communicate and advertise their slopes and lifts through visual means. Reviewing the website skimap.org, an online depository with "the most ski resort trail maps on the internet" (skimap.org, 2020) provides a good overview of the maps made for ski destinations ranging back nearly one hundred years and spanning the globe. Examples of maps from the interwar period suggest that the panoramic depiction of winter sport areas were already common. The three maps shown of Bousquet Mountain, Mt. Baker and Chamonix (Figure 2.2) depict the areas' slopes and lifts as a panorama where the mountainous landscape takes centre stage through the viewer's bird eye perspective. The natural landscape is depicted with varying degrees of accuracy and level of detail – the Bousquet Mountain panorama neatly shows seemingly each individual tree, Mt. Baker's snow-covered mountain range reveals bare rock formations here and there, whilst swaths of solid colour hint at the mountain landscape around Chamonix. Laid over the landscape on all maps are schematic lines, symbols and labels. Shown in a contrasting red they reveal lift and slope names and as for Mt. Baker and Chamonix the course of the slopes. The mountain panorama becomes a map or map-like information tool with which to spatially understand the areas and navigate through them.

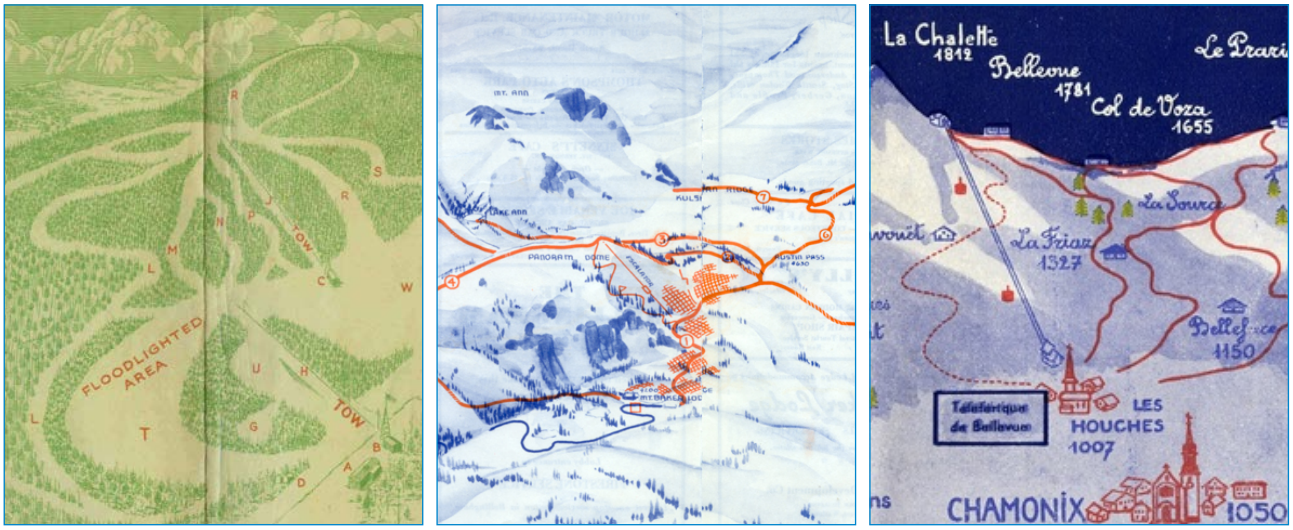

Figure 2.2: 1930s ski maps (from left to right): Bousquet Mountain (1936); Mt. Baker (1936); Chamonix. (1938). Source: skimap.org (CC BY-NC-SA 3.0 license)

Over time the panoramic view overlaid with slopes, lifts and labels established itself as the common form of depiction even as alternative ways of showing ski infrastructure were used throughout the decades albeit to a significantly lesser degree. Figure 2.3 shows examples of different types of visualisations of North American ski destinations, including one of Snow Valley from 1947 where the slopes, shown as areas of varying widths rather than two-dimensional lines, are adorned with illustrations of skiers ascending and descending the mountain, some of them in seemingly unfortunate positions lending the map a comical and light-hearted character. The positioning of the skiers illustrations suggests that the artist may have drawn them not just as decorative elements but to indicate slope characteristics such as steepness. A zoomed in section of the map (Figure 4) shows a skier moving along upright (top) going along a horizontal stretch of slope suggesting flat terrain. Another skier is seen hurtling down the slope in the left of the image suggesting a steep descent. Finally a skier is seemingly trudging back up a slope, his direction corresponding with the upward direction of the slope. These details might also be considered so called *easter eggs* left by the artist to be found by those who look particularly closely at the map.

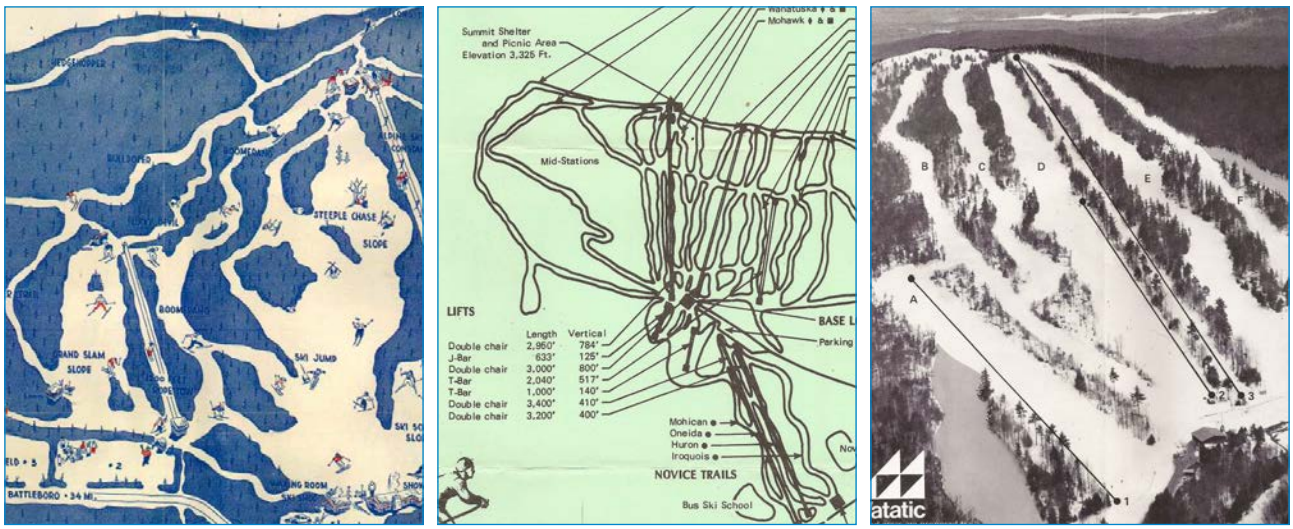

Figure 2.3: Alternative visualisations (from left to right): Snow Valley (1947), Belleayre Mountain (1978) Watatic (1980).
Source: skimap.org (CC BY-NC-SA 3.0 license)

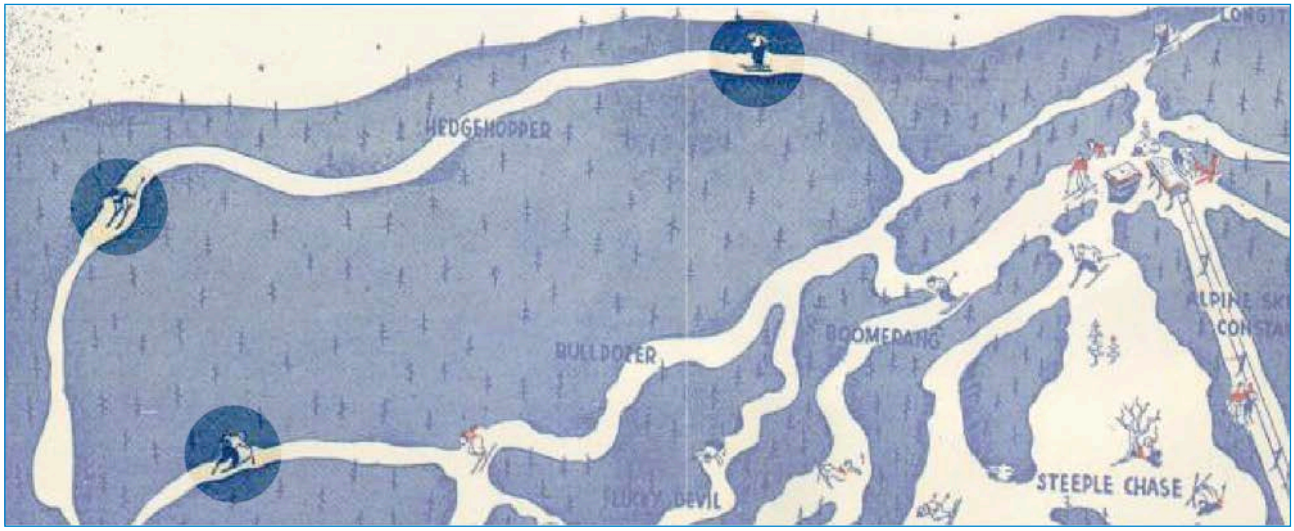

Figure 2.4: Detail of Snow Valley (1947) Communicating slope characteristics through pictorial illustrations.
Source: skimap.org (CC BY-NC-SA 3.0 license)

The line drawing of Belleayre Mountain (1978) on the other hand resembles a schematic drawing found in a user manual. Due to the lines being so close together or even overlapping, the user may have found it difficult pairing the labels with the correct slope or lift. However, just as in the Snow Valley map, the slopes are depicted as areas and not lines, giving the reader the opportunity to infer their width and from that assess how suitable they might be in relation to his or her skill level, although no indication of steepness is provided. A better judgment of the terrain may be possible through the third map shown in Figure 2.4. The former ski area of Watatic (NY) used an aerial photograph taken at an oblique angle to showcase their slopes. The black and white image contains labels and denotes the lifts as single straight lines with rounded start and end points. The stark contrast between the dark wooded areas and the white slopes that run through them clearly shows the true width of the slopes, while a hut at the bottom of the hill could serve as a reference for scale. The steepness of the slopes can also be assessed thanks to the photograph having been taken at an angle rather than head on.

Although a systematic and structured review of all 13,997 maps available on skimap.org at the time of writing was not performed as part of this thesis, a preliminary review of several dozen maps throughout the decades and across different continent suggests that whether it is in North America,

the European Alps, Russia or Japan, the mountain panorama has become the dominant type of ski map. Despite this overall commonality in map type, distinct visual differences between panorama maps from different parts of the world can be identified.

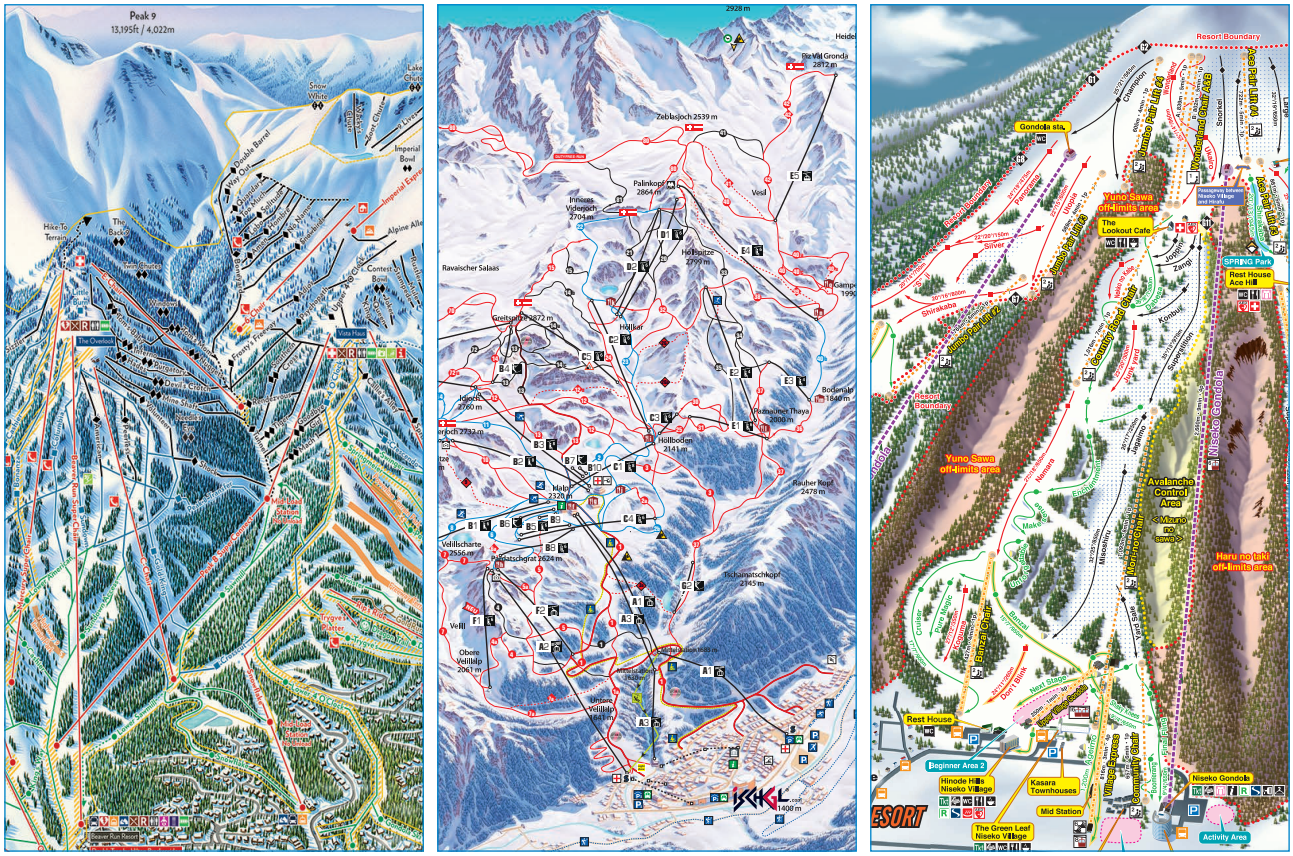

Figure 2.5: Ski panoramas from across the world (from left to right): Breckenridge (USA), Silvretta Arena (Austria), Niseko United (Japan). Source: skimap.org (CC BY-NC-SA 3.0 license)

Figure 2.5 shows sections of ski panoramas from North America, Europe and Asia respectively. Each example contains visual features that are typical for their respective world regions. North American ski maps for example, like the map of Breckenridge (left) are characterised by an abundance of trees painted at a high level of detail. Unlike maps from the European Alps where trees also feature but tend to be snow covered, wooded areas on North American ski maps appear green with only the slopes covered in snow. The visual contrast between green wooded areas and white slopes strongly emphasises the slope areas and helps create a visually concise network of pistes. Just as North American maps further encode slopes with lines coloured according to skill level and labelled with the slope name, maps from the Alps such as the example of the Silvretta Arena (centre) also overlay colour coded lines representing slopes but do so on a continuously snow covered landscape. Here trees are visible but seem snow covered and tend to appear in darker blue shades. Similar to their North American counter parts, maps from Japan tend to follow the approach of distinguishing discrete slope areas from green forests. The panorama of Niseko United (right) also uses different colours to denote slope types. In comparison to the maps from North America and Europe maps from Japan appear much more descriptive as they contain many larger labels providing detail about specific points of interest within the ski area. Another unique stylistic element is the inclusion of direction arrows at the end of each slope line, informing the user of the direction in which each slope descends. Such directional clues can be found on ski maps from the European Alps but only for slopes where the direction of the terrain is unclear. The map of Niseko United features information about slope incline and length (Figure 2.6 centre). Asian maps also differ in the way they appear to have been generated. Whereas maps from both North America and Europe are

mostly based on hand-painted panoramas with the information about man-made structures such as lifts and slopes added digitally, Asian maps including the underlying mountain panorama seem to be fully computer generated.

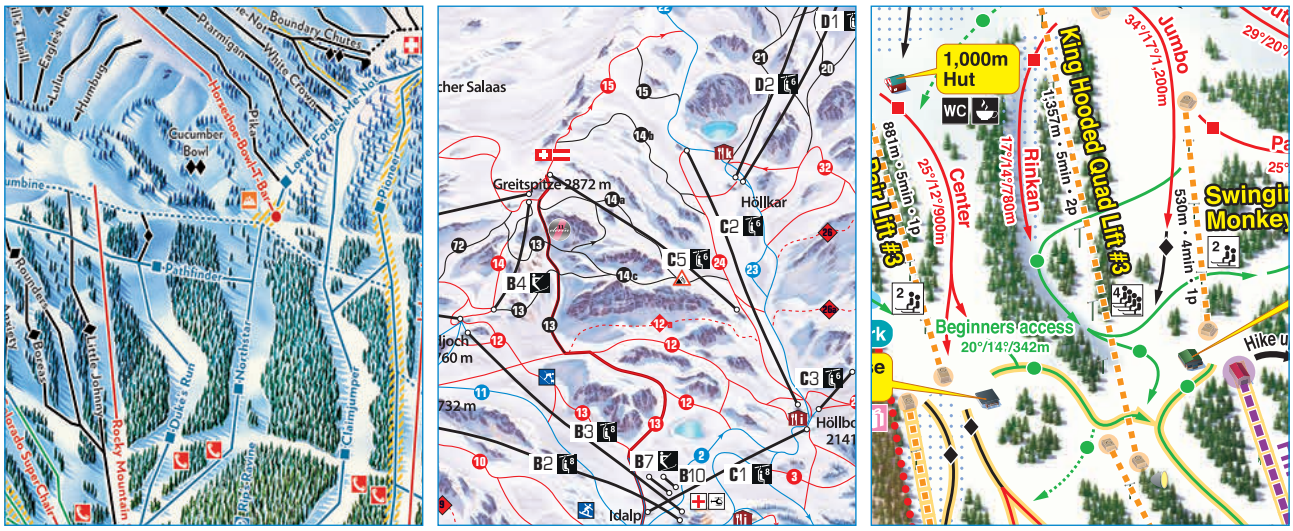

Figure 2.6: Details of maps from across the world (from left to right): Breckenridge (USA), Silvretta Arena (Austria), Niseko United (Japan). Source: skimap.org (CC BY-NC-SA 3.0 license)

In the case of the USA and Canada Tait's study *The Mountain Ski Maps of North America – A Preliminary Survey and Analysis of Style* (2012) found that "panoramic views dominate ski trail maps [and] comprise 86% of all maps and 100% of maps for the top 100 resorts". Although such a systematic study could not been found for the European Alps a review of the official ski maps published by the largest ski areas in Tyrol Austria mirrors Tait's findings. Figure 2.7 provides a visual overview of the official ski maps published and distributed through their websites by the eleven largest ski areas in Tyrol Austria. Some of these are also the largest areas in all of Austria. All eleven destinations provide a panorama map to showcase and inform about their ski area. These maps can either be viewed as interactive images showing the current lift and slope status or can be downloaded as PDFs. Figure 2.7 not only shows the dominance of the mountain panorama but also the high level of similarity in style.

The ski panorama as found throughout the European Alps offers a captivating view across an expanse of pristine snow covered mountain peaks and valleys criss crossed by a network of slopes and lifts, all under a clear blue sky. Painted by hand the viewer can make out individual trees and buildings whilst also looking afar to prominent peaks in the distance far beyond the actual ski area. The panorama paintings themselves are mostly very similar in terms of the colours used ranging from a bright azure blue for the sky to whites and light blues for the snow and darker blues and purples for shaded rock faces and wooded areas. The colour coding of the slopes is set according to each country's standards, Austrian ski maps use blue for easy, red for intermediate and black for advanced slopes according to the ÖNORM S4610 4611 (Amt der Tiroler Landes Regierung Abteilung Sport, 2015). Fonts, colours and icons for lifts and amenities however tend to follow each ski area's branding guidelines (Figure 2.8).

In the 1950s alpine winter sport resorts in both Europe and North America started to create and publish maps and map-like depictions in order to showcase their slopes, lifts and amenities off the pistes such as accommodation and gastronomy. On both sides of the Atlantic a few individuals emerged to become the preeminent artists who were at the forefront of creating ski maps and influencing a broader style. In North America Hal Shelton and Don Moss are credited with being the "seminal practitioners in the history of American trail map art" (Masia, 2005). In Europe, the Austrian Heinrich C. Berann is considered the originator of modern panorama painting (Dauer, 2019). All three

Table 2.1: The largest ski areas in Tyrol, Austria and the type of ski maps they provide.
Source: Skiresort.de, 2020

Ski Area	Slopes (km)	Number of lifts	Primary map type	Secondary map type
Ski Arlberg	303	88	Panorama	None
SkiWelt	284	90	Panorama	None
Skicircus	270	70	Panorama	None
Silvretta Arena	239	45	Panorama	None
Kitzbühel	234	57	Panorama	None
Serfaus–Fiss–Ladis	214	68	Panorama	Interactive terrain map
Sölden	144	31	Panorama	None
Zillertal Arena	143	52	Panorama	None
Mayrhofen	142	58	Panorama	None
Gurgl	112	25	Panorama	None
Alpbachtal-Wildschönau	109	46	Panorama	None

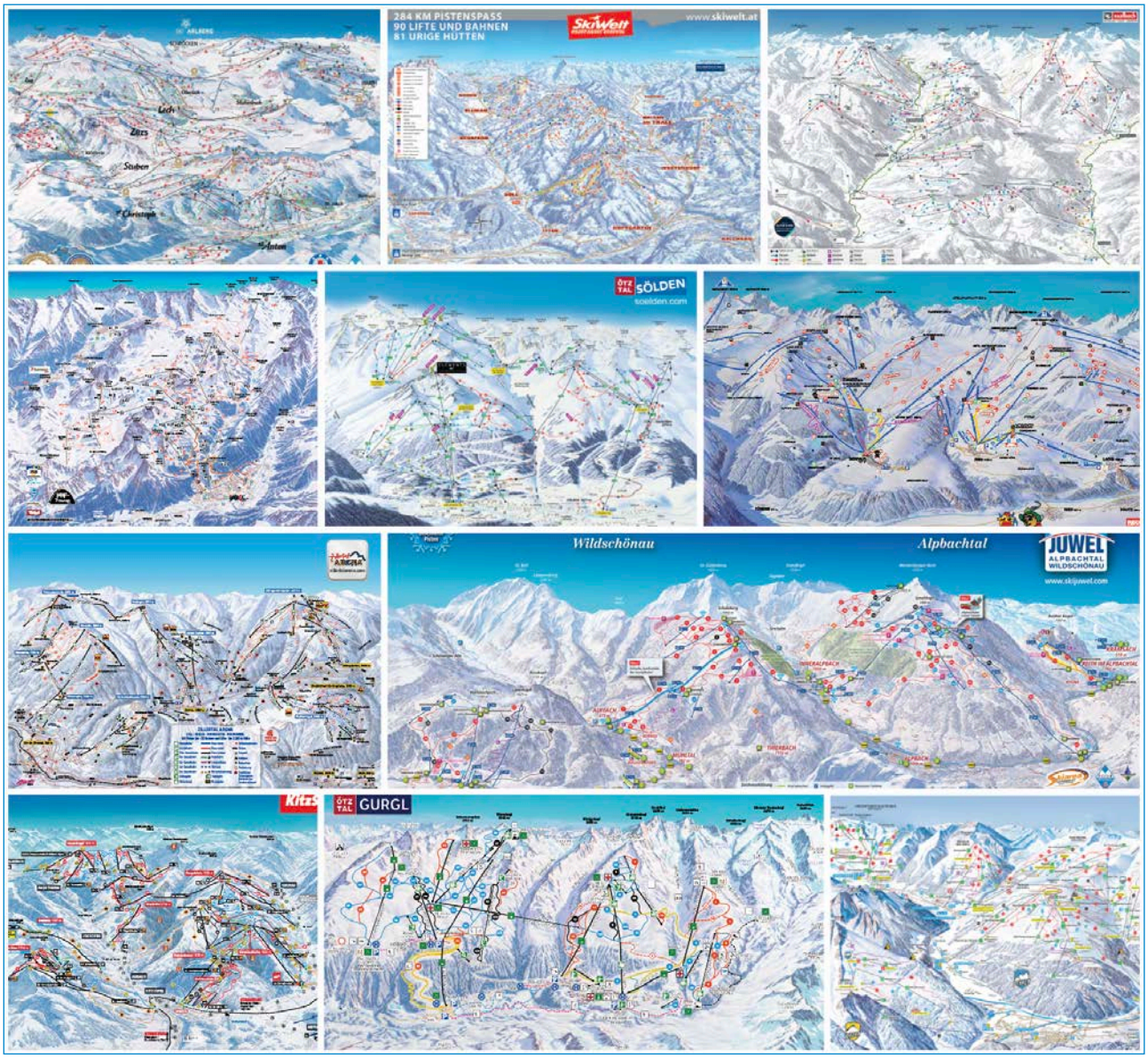

Figure 2.7: Panorama maps of Tyrol's largest ski areas.
Source: skimap.org (CC BY-NC-SA 3.0 license)

responded to ski resorts' increased need to visualise the increasing complexity of lift and slope networks. According to Masia (2005) the "construction frenzy" of American resorts in the 1960 saw an average of 150 new lifts each summer. As ski resorts also made use of colour advertisement and colourful brochures to market themselves sophisticated trail maps started to be at the heart of their marking campaigns (Masia, 2005).

Since the eighteenth century the panorama has been around as a mean to reproduce and exhibit views of large landscapes. Comment (1999) describes how the idea for the panorama was born after painter Robert Barker viewed Edinburgh from the top of Carlton Hill on a walk in 1787 and thought to capture the "splendid vista" as a 360° view. The first panoramas were large circular installations, also called rotundas, inside which visitors could behold a seamless 360° image of cities, countrysides or even battlefields (Comment, 1999). Figure 2.9 shows a woodcut by C.V.Nielsen, which illustrates the such a panorama attracting visitors throughout the second half of the 19th

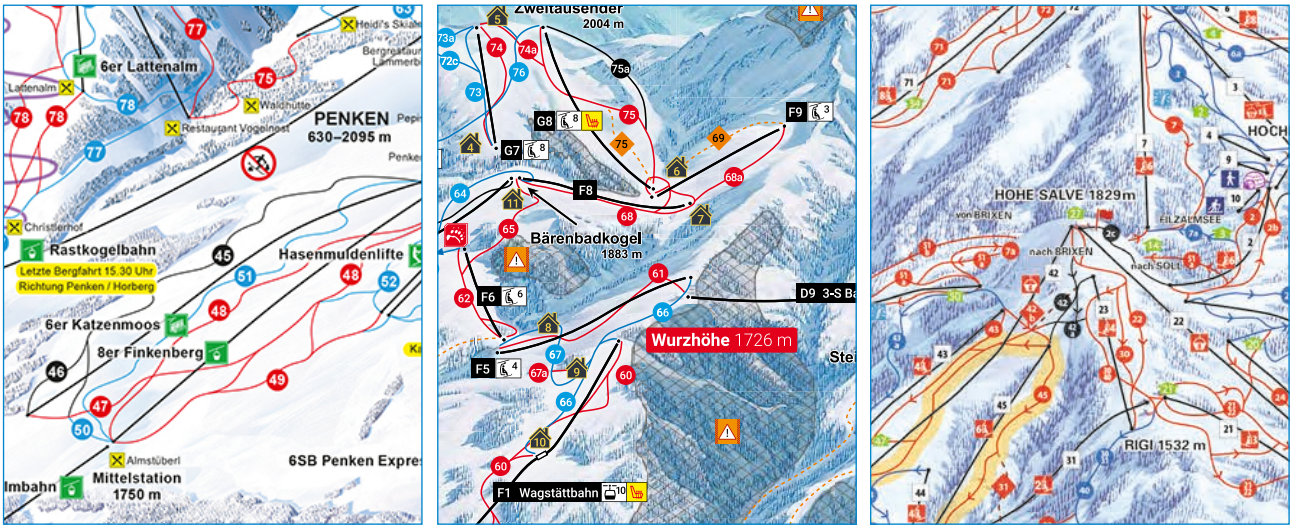

Figure 2.8: Details of ski maps from Tyrol (left to right): Mayrhofen, Kitzbühel, SkiWelt Wilder Kaiser - Brixental. Source: skimap.org (CC BY-NC-SA 3.0 license)

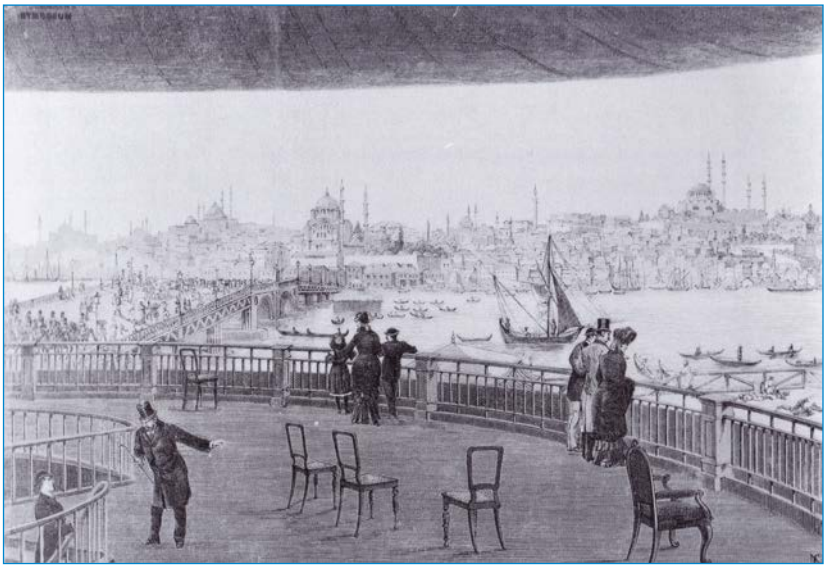

Figure 2.9: Visitor platform in Copenhagen during the second half of the 19th century showing a panoramic view of Constantinople. Source: C.V.Nielsen cited in Comment (1999)

Figure 2.10: Circular view of the mountain range as seen from the peak of the Buet glacier. Source: Horace-Bénédict de Saussure cited in Comment (1999)

Figure 2.11: Saas-Fee ski resort, Switzerland, painted by H. C. Berann in 1962.
Source: skimap.org (CC BY-NC-SA 3.0 license)

century. Comment reckons that even before the emergence of such large and accessible panoramas, cartography itself may have had an influence on the panorama as a type of visualising places. He cites Horace-Bénédict de Saussure who illustrated his book *Reisen in die Alpen* (1779–96) with circular panorama views of the mountainous landscapes he had encountered (Figure 2.10).

According to Dauer (2019) the neologism *panorama*, a combination of the greek words *pan* for *all* and *horama* for *view* describes an art form that is not only lacking a "universal definition", nor is its application to a flat paper rather than a curved surface such as the inside of a rotunda considered by encyclopaedias and dictionaries. Indeed, a look at definitions provided by Merriam-Webster (2020) and the Oxford Learner's Dictionaries (2020) define the term as "an unobstructed or complete view of an area in every direction" and "a view of a wide area of land" respectively. Neither suggests a particular medium through which the view is expressed such as a painting or a rotunda. Lacking a formal definition, Dauer (2019) suggests that the panorama as being painted on paper or canvas is a hybrid, located somewhere between photography, art, cartography and the world view of people".

H. C. Berann's first panorama depicted the Grossglockner High Alpine Road, which opened in 1935. In his book *Alpen – Die Kunst der Panoramakarte* Dauer (2019), quotes H. C. Berann (1968) who describes his struggles "to put a landscape on paper that in reality no human could comprehend in its entirety". This struggle lies at the crux of panorama paintings. Like Berann, every panorama painter needs to achieve the impossible – depicting a landscape in a way that brings out and makes visible all its desirable features but somehow represents the environment in such a way that the viewer accepts it as a suitable depiction of reality. In order to show all whilst focusing on the most desirable parts panorama, painters might tweak reality heavily. Peaks are omitted or added, terrain may be raised or lowered depending on the purpose of the panorama. For example, Berann would sometimes decrease the size of a mountain range for the winter panorama compared to their size in the summer panorama in order to make the ski slopes and lifts appear larger and more prominent (Dauer, 2019).

Field (2010) suggests the reason for panoramas being so extremely popular is that they are expressly artistic and provide a visually stimulating image of the landscape, which people can readily identify with. Indeed it could be argued that the panorama resembles more a photograph than a map. As a result and not being a strictly defined visual medium the panorama is able to achieve something “truly magic” as “readers feel drawn into the panorama as if they were flying high above the land” (Patterson, 2002 cited in Tait, 2012). Tait (2012) further muses that “the panoramic ski map may be particularly evocative of the mountain terrain for skiers and potential skiers for whom the feel of the image may replicate the feel of flying down the mountain on skis.” A panorama by Berann from 1962 of Saas-Fee in Switzerland (Figure 2.11) illustrates the visual attractiveness of this art form well. The natural landscape appears realistic. Viewed through a birds-eye perspective, the viewer seemingly standing atop a mountain, the image appears three-dimensional and almost within their grasp. Shading on the side of mountains and ridges as well as blurring towards the background lends it further depth. The addition of visual variables found in normal maps such as lines, symbols and text turns the panorama painting into a map-like image that not only has the ability to entice the viewer and advertise the area’s formidable skiing conditions but also provides cartographic information about the location of slopes and lifts within the landscape.

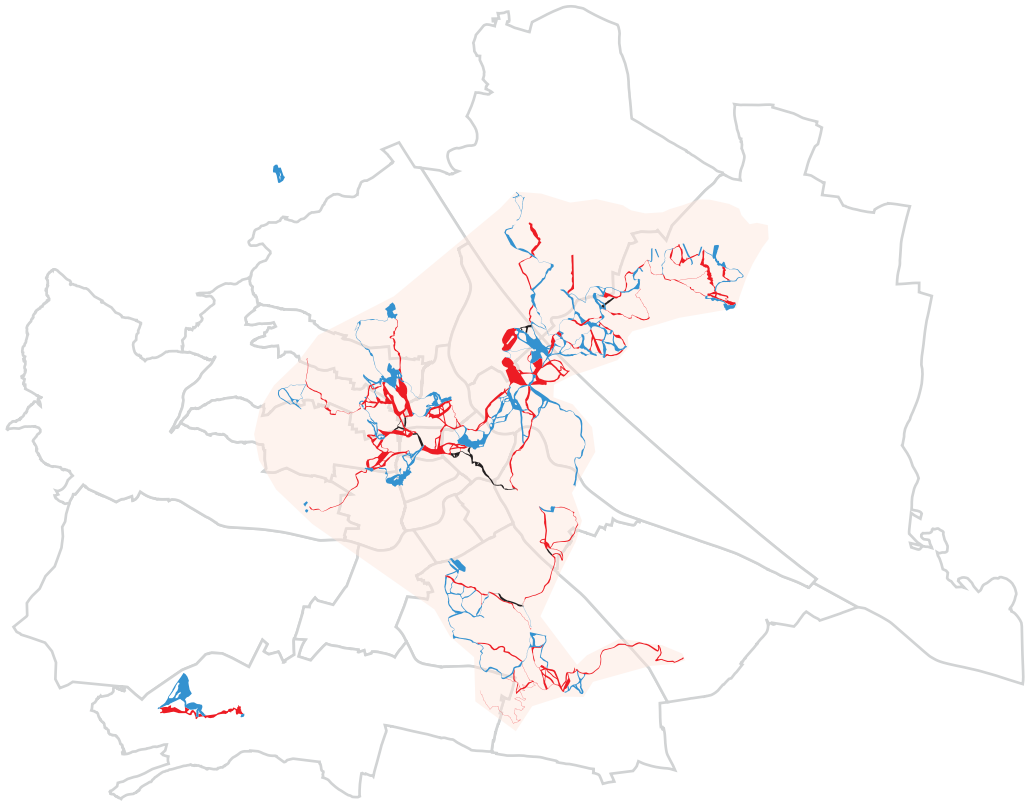

Figure 2.12: The slopes of the SkiWelt overlaid onto Vienna.
Source: Janssen (2019)

In the 1960s most ski areas, like Saas-Fee, were comparatively small and easy to comprehend with regards to the number of slopes and lifts they offered. However, smaller ski areas have and are increasingly being consolidated into larger interconnected ski areas (Süddeutsche Zeitung, 2020 and King, 2017). In order to attract visitors in a more and more crowded market, cable car operators who are also responsible for the upkeep of the slopes and creation of artificial snow, join together to offer a larger ski area accessible through just one ski pass. Often marketed under one umbrella name as in the case of *SkiWelt - Wilder Kaiser - Brixental* or *SkiCircus Saalbach Hinterglemm Leogang Fieberbrunn* the overall area is made up of discrete sub-areas associated with local villages, which have their own cable car stations and act as gateways into the ski area. The size of some of these

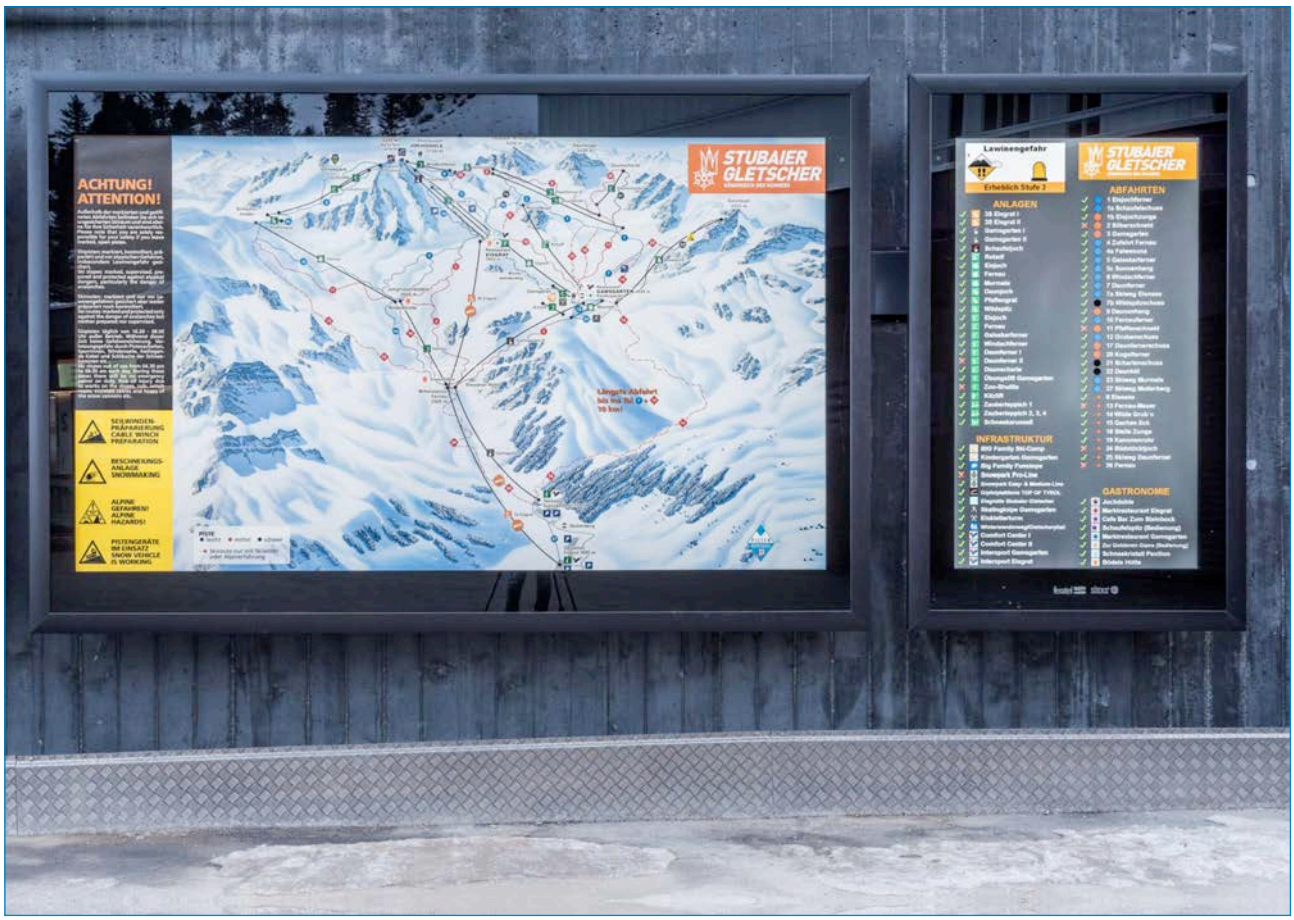

Figure 2.13: Example of a digital signage panorama infosystem.
Source: feratel media technologies AG & sitour Marketing GmbH (2017)

large interconnected ski areas can be impressive. Figure 2.12 shows just how large the SkiWelt is when overlaid on Austria's capital Vienna. One could ski all the way from Donaustadt in the north across the city centre to Favoriten in the South and back up to Döbling. As a result of the ongoing consolidation the networks of slopes and pistes have become increasingly complex.

Whilst huge investments are being made into upgrading technology including snow cannons and lift infrastructure, navigation and orientation elements on and off the slopes have remained largely the same. This is not to say that the hardware such as information boards and web-based functionalities have seen some changes. sitour Marketing GmbH, a specialist company for advertising and technology offers various digital solutions for ski areas. These solutions include orientation and navigation elements such as a "digital signage panorama infosystem" (Figure 2.13), which contains a back-lit panorama map and a status display showing real-time-information about lift and slope openings and closures (feratel media technologies AG & sitour Marketing GmbH, 2017).

Despite the development of new and innovative information displays, the maps they display have remained the same. Panoramic depictions of ski area, even of the largest and most complex, still dominate due to several factors. Field (2010) cites Fry (2007) who reasoned that, amongst other factors, "with more money flowing into the sport, more attention has been paid to marketing materials". Field further cites to Phillips (2007) and Niehues (2009) who argue that the accurate portrayal of the mountainous landscape may be secondary to the ski area's marketing objectives which require the landscape to "appear more impressive". Thirdly, even though a panorama map of a large area such as the SkiWelt might look confusing at a closer look, the overall view of the mountains and valleys covered in pristine snow underneath blue ski creates a yearning for the mountains that probably few other maps and map-related depictions can achieve.

Tyrol's eleven largest ski areas all use the panorama map as their primary medium to communicate the area geographically (Table 2.1). Ten of of these areas had no alternative map. Only the ski area of Serfaus-Fiss-Ladis, provided an alternative map of the area: the "2D Winter Panorama" (Serfaus-Fiss-Ladis Tourist Board, 2020), a digital and interactive terrain map showing lifts, coloured slopes and the location of huts overlaid on a digital terrain model (Figure 2.14). The map has some interactive functionalities with the user being able to select objects and getting more detailed information. However, it was not possible to assess the full extent of the information potentially available. A reason maybe being that the winter sport information is not being available during the summer at the time of writing. The article *Mountain Ski Maps of North America – A Preliminary Survey and Analysis of Style* (Tait, 2012) found that planimetric maps made up only 6% of all maps. He noted that planimetric maps were mainly used to depict Nordic skiing routes. However, as mapping services such as Google Maps or maps published based on Open Street Map data visualise outdoor related geospatial information such as ski slopes and lifts more and more, viewing this information on the plane as opposed to a panorama may become more common. Figure 2.15 shows Google Maps visualised slope and lift infrastructure on top of its terrain map.

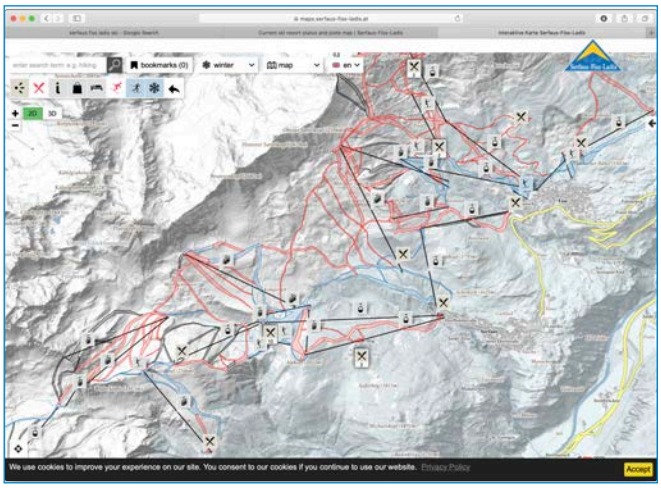

Figure 2.14: "2D Winter Panorama" provided by Serfaus Fiss Ladis. Source: Serfaus-Fiss-Ladis Tourist Board (2020)

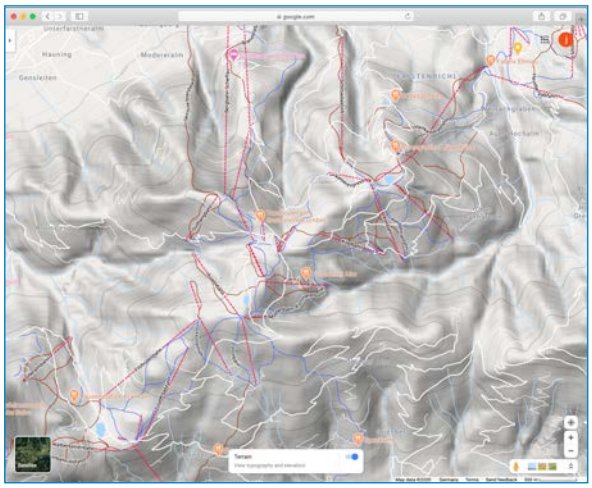

Figure 2.15: Ski slopes and lifts as shown by Google Maps. Source: Google Maps (2020)

2.3 Usability of ski maps

Panorama maps and with them ski maps have received considerable attention with regards to the their creators and the techniques they used (Dauer, 2019; Tait, 2008; Patterson, 2000; Antoniou et al., 2015). How ski maps perform once they are in use has been studied to a far lesser degree. Only a handful of studies, which focused on the usability of ski maps were identified for this thesis research including *A Study on Mental Representations for Realistic Visualization – The Particular Case of Ski Trail Mapping* carried out by Balzarini et al. (2015). In this study participants carried out wayfinding tasks concerned with navigation and locating points on the map. Aside from observing which information skiers would glean from the ski map the researchers also observed the French panorama artist Pierre Novat in his studio whilst he was creating a ski map. As a result of the "user-skier activity" and "expert-artist activity" the researchers identified particular graphic objects associated with ski maps, which they organised into five taxonomic categories: geography, geomorphology, tracing, structures and nomenclature. They then presented information that each, the artist and the skier, would associate with a particular object and how the two view points would

differ. The study shows the difficulties of processing information by users when trying to interpret the objects painted by the artist. For example whilst the artist employed the depiction of rocks and cliff in order to structure the mountain relief, the users would use this visual information to estimate possible crossings. The results of this study show that the majority of difficulties (30.9%) are associated with geomorphological objects such as the depiction of peaks, ridges or terrain profile and slopes, followed by 27.3% of users who struggled to understand so called tracing objects (ski slopes and lifts). The authors concluded that the areas of the ski map created with a high degree of "invention" by the artist are most likely to cause difficulties in understanding. Furthermore, the results of the study show that the way the panorama map is drawn leads the user to experience difficulties when performing tasks related to wayfinding and orientation.

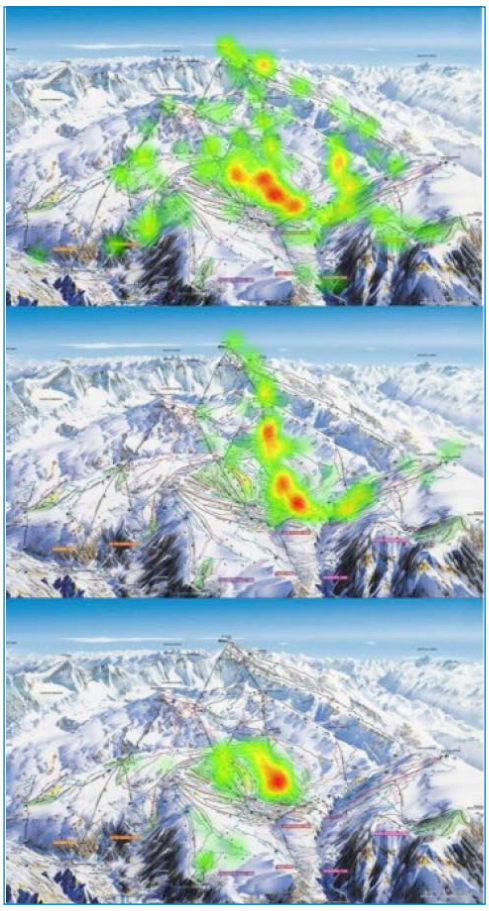

Figure 2.16: Heat maps of exploration and assessment of a ski area by advanced, intermediate and beginner skiers (top to bottom). Source: Balzarini and Murat (2016)

Balzarini and Murat (2016) conducted a further study related to the usability of ski maps: *The Effectiveness of Panoramic Maps Design: A Preliminary Study Based on Mobile Eye-Tracking*. As in the previous study a panorama by Pierre Novat of the French ski area Alpes d'Huez was examined from the user's point of view, but this time with the use of eye-tracking (Figure 2.16). The authors created a gaze data protocol based on a few experimental questions such as "what areas of the ski map are explored by the gaze?", "What are the most gazed graphic objects and why?" and "What areas of ski map pose difficulties?". As for the previous study participants were assigned to three different ski skill levels. This study found that whereas at the start of viewing the panorama participants tended to view its central part, subsequent viewing behaviour differed according to the user's skill level. Whilst users at beginners level were found to focus on the "very central area of the ski resort", advanced skiers "sweep" the ski area within its boundaries, suggesting a more complete view of the map. Intermediate skiers focus on "on the central axis of the domain to reach the highest peaks". Counting fixation points on the map as well as the time spent on them revealed that the vast majority of points were associated with objects in the tracing category such as slopes and lift, thus showing that the network of paths is focused on the most. The authors also presented results relating to the specific tasks users would use the map for, showing that the ski map was met useful to obtain tracing related information such as finding the start point (66.7%), asses the difficulty of ski slopes (56.8%) and identify connections within the network (56.8%) (Balzarini and Murat, 2016). In terms of geomorphological features that were deemed most useful, the elevation value and peaks featured highly with 42.% and 41.3% respectively. Balzarini and Murat (2016) concluded that users focused mainly on linear features on the map, a finding that Field (2010) also found in his study *Gravity is your friend but every turn is a leap of faith: design and testing a schematic map for ski resort trails*.

Following Vail Resorts' decision in 2007/08 to replace their hand painted ski map of the Breckenridge resort by a computer generated panorama map, Field (2010) decided to explore the schematic depiction (Figure 2.17) of the ski area as an alternative to the status-quo and newly emerging digital panorama maps. His study takes the reader through his process of creating the schematic ski map and an in situ user test with a printed version. Field chose 26 participants for his in situ experiment, all of which were new to the resort but had prior skiing or snowboarding

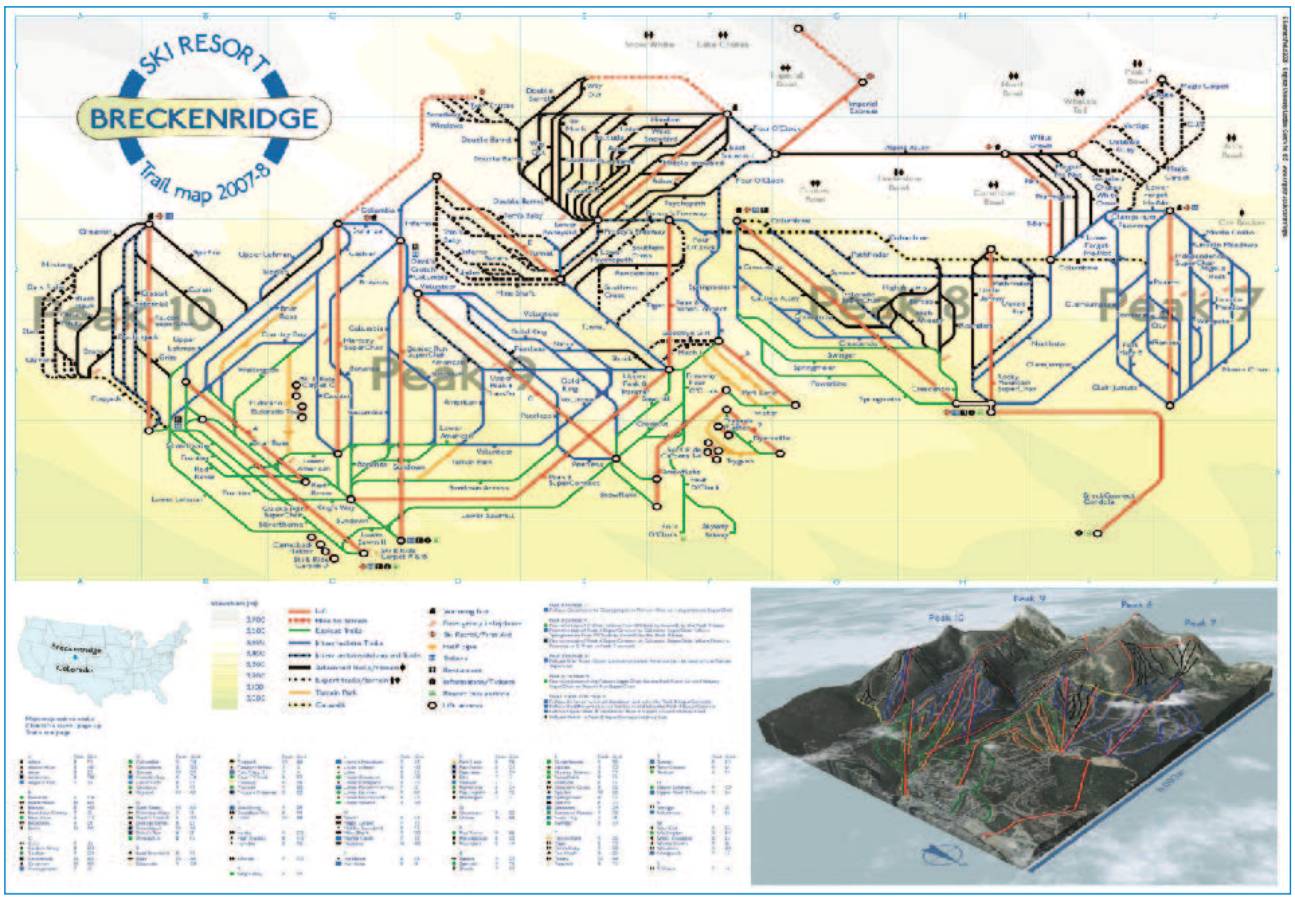

Figure 2.17: Schematic ski map of Breckenridge.
Source: Field (2010)

experience. The results concluded that the schematic map was well suited to understanding the network of slopes and lifts. 15 participants agreed that the map was "very suitable for accurate navigation". The majority also appreciated the ability of the to provide "rapid route information" suggesting that the time takes to understand its contents is comparatively short. For all the advantages of the schematic map 80.7% of participants still found the inclusion of the panorama map as an inset useful (50%) or very useful (30.7%). Field concluded that aside from more advances skiers or snowboarders, those who were familiar with network maps such as subway maps found the schematic map easier to use. In relation to an existing level of familiarity with certain map types Field notes that the "familiarity of the panoramic mapping genre was so well established and understood that any alternative would be challenging" (2010).

2.4 Wayfinding and spatial cognition

In his book *The Image of the City* (1960) Kevin Lynch argues that "in the process of way-finding, the strategic link is [...] the generalised mental picture of the exterior physical world that is held by an individual". Golledge (1999) later describes wayfinding as a "process of determining and following a path or route between an origin and a destination". The cognitive or mental map is informed by the recognition of a person's surroundings and the spatial patterns identified. The clearer and more legible this image is, the more easily and quickly a person moves around Lynch argues. According to Golledge (1999) the route itself needs to be legible in order to "learn" the environment and thus create a coherent image of it. The most common methods to obtain a mental image of the environment are based on actively experiencing it by moving through it or through obtaining an elevated view over it, for example from a hill or mountain peak, or the use of secondary information

provided by maps or photographs (Golledge 1999). These two methods are referred to as route-based and survey-knowledge respectively. MacEachran (1992) argues that route-based knowledge contributes most to the spatial knowledge of a person with secondary aids such as maps supporting the development of a mental map. The mental image of a place is is not a photographic replica before one's eyes but is primarily made up of geometric images associated with geographic meaning. At its core a cognitive map or mental image contains features represented as points, lines, areas and surfaces (Golledge, 1990 cited in Golledge, 1999). Similarly, Lynch (1960) categorises features of a mental map as paths, edges, districts, nodes and landmarks. Figure 2.18 shows a mental map of Boston, which uses Lynch's five spatial elements. In terms of the types of environments considered, most research about human's wayfinding and spatial cognition focuses on urban settlements such as cities. Case studies often focus on entire cities (Lynch, 1960), urban parks (Boumenir et al., 2010), or smaller, individual elements of the built environment (Caduff and Timpf, 2008). The examination of spatial environments as specific as ski areas has been studied to a far lesser degree.

Field (2010) and Balzarini and Murat (2016) found through their tests that ski map users largely focus on linear features on ski maps, namely the network of ski slopes and connecting ski lifts. The eye-tracking study related to ski map usability (Balzarini and Murat, 2016) suggests not only how a ski map might be used but also how the ski area is understood spatially. Alpine skiing for its most part is an activity based on moving through space along defined routes. For safety and environmental reasons skiers and snow boarders are expected to use purpose-built lifts to ascend the mountain and descend it on groomed slopes spatially defined by slope markers located along the edge at regular intervals. The linear routes create nodes at the point where they begin and end at a lift or hut and where they intersect each other. What Lynch refers to as districts might be recognised as discrete smaller areas associated with a peak or village within the larger ski area.

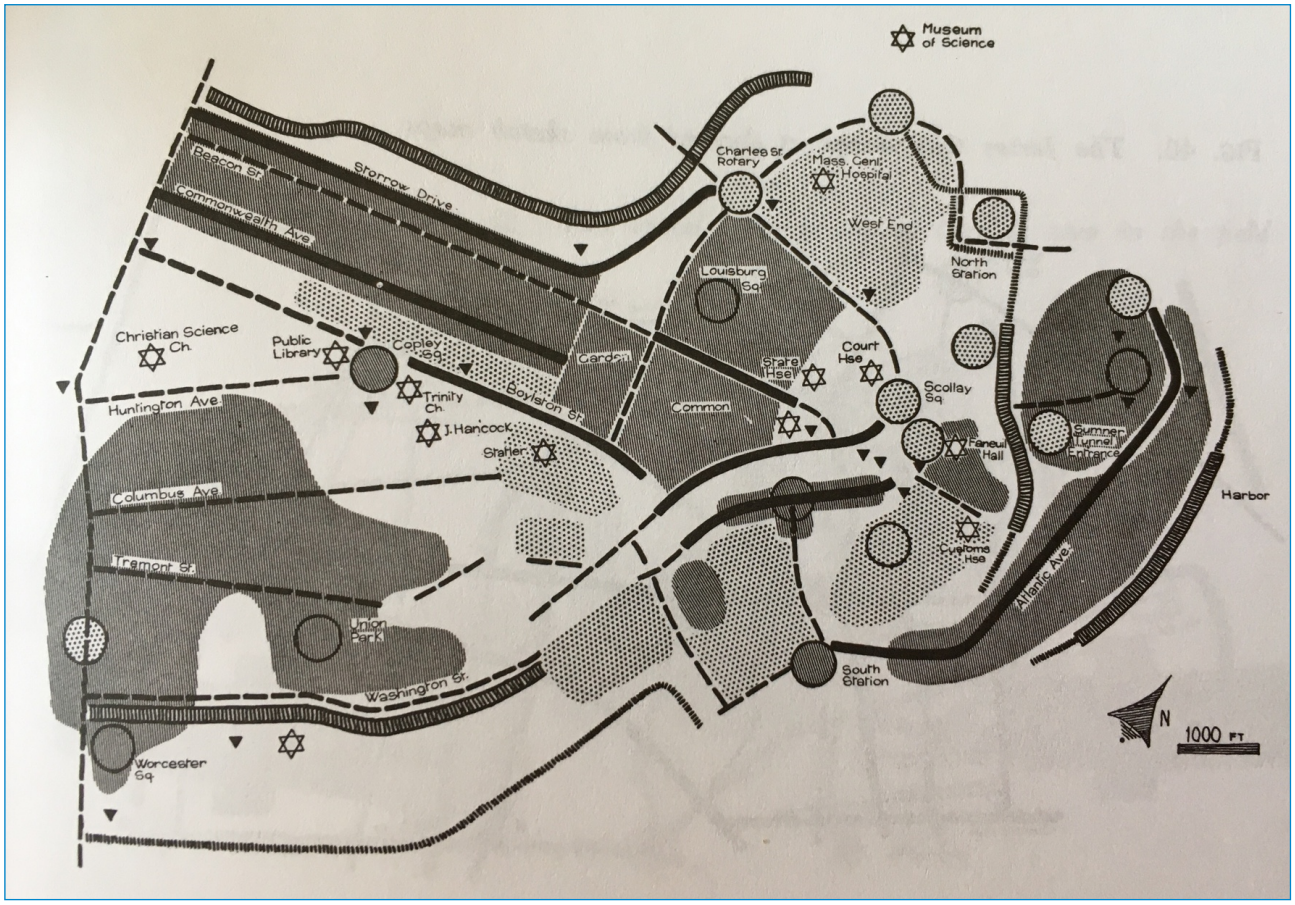

Figure 2.18: Boston depicted through 5 spatial elements.
Source: Lynch (1960)

Lift stations often function as visual landmarks and so do huts for eating and drinking. Lynch described edges as penetrable and impenetrable boundaries between areas that differ from each other. In a ski area a boundary may be the edge of the groomed slope beyond which one may find dense forest or off-piste areas.

2.5 Marketing, maps and the image of place

Maps are recognised as frameworks through which to represent and communicate places (MacEachren, 1995; Monmonier, 1993; Robinson and Petchenik, 1976; cited in Warnaby, 2008). The mapping process can be broken down into the following stages, starting with a data model which is encoded by the map maker who creates a map, which is then received by the map reader or user who in turn decodes the map and creates a mental map and with it an image of the mapped place. This basic framework is also applicable to place marketing where the marketer encodes the place, creates a marketing message which is decoded and interpreted by a target audience who gains an impression of the place (Warnaby, 2008). In both cases, the map and destination image have a "shared need to communicate a limited version of the truth" (Monmonier, 1996). Monmonier asserts that both, a marketing tool such as an advertisement and a map, need to be selective in terms of how they are communicating a place, which inevitably leads to the omission of certain information. Advertisements, which include place marking, select information in order to promote, differentiate or suppress facets of the marketed places. Monmonier further states that "maps are proven attention-getters" whether they "decorate" or merely "inform" the viewer. Maps have functioned as elements of marketing messages for a long time (Warnaby, 2008), from as early as the 18th century, when they were used as a tool associated with US city boosterism (Ward, 1995 cited in Warnaby, 2008) and later for the representation and marketing of English *garden cities* (Hunt, 2004; Ward, 1992 cited in Warnaby, 2008). Map as a marketing tools, which help define an image of a destination, such as a ski map, saw a noticeable increase in the second half of the 20th century (McDermott, 1969 cited in Warnaby, 2008; Fry, 2007 cited in Field, 2010). Crompton (1979) defines the term *destination image* as "the sum of beliefs, ideas and impression that a person has of a destination" (cited in Komppula and Laukkanen, 2015).

That the ski map is primarily a marketing tool has been noted by several researchers including Tait (2008), and Phillips (2007) and Niehues (2009) both cited in Field (2010). As it contributes to defining the destination image, it is important to the destination's viability and success (Tasci and Gartner, 2007 cited in Komppula and Laukkanen, 2015). However, unlike other maps and map-

Figure 2.19: Panorama maps of SkiWelt Wilder Kaiser - Brixental promoting the area and its visitor attractions and tourism infrastructure offered during the summer (left) and winter (right) seasons.
Source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020)

related marketing elements, which may be produced with a solely decorative purpose in mind, it may be argued that the ski map has to play a dual role. Aside from "delivering the desired image of the destination" (Komppula and Laukkanen, 2015), it is also expected to be an orientation and navigation tool. Thus, the panorama map, whether it is a map created for the summer or winter season (Figure 2.19) has to achieve two objectives, both of which could result in different cartographic depictions if taken in isolation. Meaning that a ski panorama needs to be both, visually enticing, such as it is, by showcasing the area's natural and topographic features, whilst at the same time, provide useful and reliable information with which users can navigate through the area from point to point. Based on the way it is made, by combining traditional painting methods with digital vector graphics, to the information it conveys, near-realistic depiction of the landscape and topography overlaid with symbols and simplified line features, the place image it creates, and thus perception, may vary depending on the visual elements users focus on and when they use it. Used to showcase the ski area and provide an overview of it the attractions it has to offer, the panorama is likely to maintain its role as marketing tool prior to a trip to the ski area. However, used at the destination and on the slopes, the same map may not be seen as a marketing tool but studied more closely to find points of interest and work out directions. The panorama map has an impact on the user's perception of the place and with that evoke an emotional response. Both the perception and emotional response may vary depending on when, where and for what purpose the panorama map is used. It has been found that users have difficulties in using 3D maps to extract information effectively and efficiently (Bleisch et al., 2008 and Harrower, 2007 cited in Griffin and McQuoid, 2012). This critique also applies to ski panoramas as concluded by Balzarini and Murat (2016) and Balzarini et al. (2015). Yet, as Griffin and McQuoid (2012) state: "many map creators continue to use these forms of representation because map users report liking them" inferring a positive emotional response to them.

2.6 Conclusion

Ski maps have been around since the 1930s. From the beginning the panoramic depiction of alpine winter sport areas has been the dominant. However, in the beginning different types of map-related visualisations were used though to a much less degree. As winter sport and skiing in particular developed into a mass tourism activity the panorama map manifested itself as the de facto visualisation. At the same ski resorts tended to become larger, creating interconnected destination. But as the number of complexity of the infrastructure of slopes and lifts grew, the panorama map, remained largely the same. Even though much is understood about how panorama maps are made their usability is received considerably less attention. Research int the usability of ski panoramas has led researchers to conclude that these map-related depiction indeed have their shortcomings when used orientation (Balzarini et al., 2015 and Balzarini and Murat, 2015). Aside from Field's (2010) schematic map if Breckenridge, even fewer focus has been on creating and testing alternative cartographic depictions. Tested in situ, the schematic map was perceived positively and "suitable for accurate navigation". However, Field acknowledged that the introduction of a new style of map would be a challenge if the familiarity with the existing panorama map is so well established.

The panorama map used for skiing has to fulfil a dual purpose. As a marketing tool, the birds eye view over a pristine mountain landscape covered in snow provides an enticing image of the destination, advertising its size, variety of terrain, peak heights as well as the winter sport infrastructure and activities on offer. Once at the the destination, the same map is prominently displayed at gateways to the ski area such as lifts exits and handed out as print maps to guide the skier through the destination from lift to slope to lift and so on. In conclusion, a lot is expected of the panorama map depicting alpine winter sport areas. Whilst it is lacking elements such as scale and a geographic coordinate system, characteristic of a conventional map used for navigating, one of it's main intended purposes is to be an aide for navigation and orientation.

3. Methodology

This section provides an insight into the methods used to create the primary research for this thesis. At its core is the online survey through which two different maps of the SkiWelt are evaluated by two random sample groups. After introducing the case study area and corresponding maps (Sections 3.1 and 3.2), preparatory map changes are outlined (Section 3.3) followed by a description of the expert questionnaire (Section 3.4). Finally, the objectives of the survey are explained, as well as its design and how it was distributed (Sections 3.5–3.8).

3.1 Introducing the case study area SkiWelt Wilder Kaiser – Brixental

The ski area of SkiWelt Wilder Kaiser - Brixental (hereafter referred to as SkiWelt) is located in Tyrol, Austria. Being “one of the largest […] ski resorts in the world” (SkiWelt Wilder Kaiser – Brixental Marketing GmbH, 2020) it provides over 284km of groomed ski slopes accessible by 90 cable cars and lifts. The SkiWelt is anchored by the villages Brixen im Thale, Ellmau, Going, Hopfgarten, Itter, Scheffau, Söll and Westendorf all of which are interconnected by lifts and slopes. The villages of Kelchsau and Schwoich and their respective lift and slope infrastructure form two satellite villages also belonging to the SkiWelt but are not directly connected to the main areas. Figure 3.1 provides a geographical overview of the winter sport area.

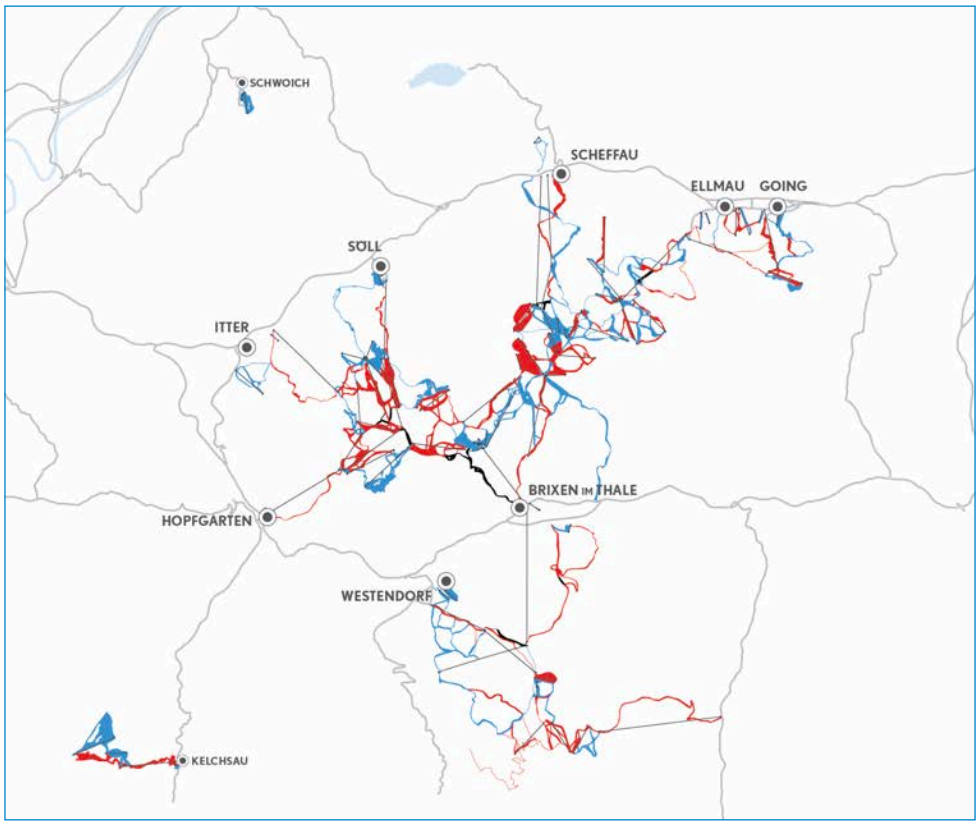

Figure 3.1: Geographical overview of the SkiWelt area.
Source: Janssen (2019)

With an elevation ranging between 620m and 1975m above sea level the SkiWelt offers a diverse range of slopes in terms of their length and steepness including very long continuous runs that connect peaks with the villages in the valley. Lifts and slopes are spatially organised around the main peaks of the area – Astberg, Hartkaiser, Eiberg, Zinsberg, Hohe Salve, Coralpe, Fleiding and Gampenkogel. The peaks are in turn connected with each other by slopes and lifts, creating many continuous skiable routes throughout the SkiWelt. Borrowing from Lynch's (1960) spatial elements to create a mental map of the SkiWelt and better understand its spatial organisation, villages and peaks could be considered as *landmarks*, lifts and slopes as *paths* and the area where lifts and slopes occur at a high density as *districts*. Breaking the SkiWelt down by elevating key paths, landmarks and districts simplifies the otherwise large and complex geographical space (Figure 3.2).

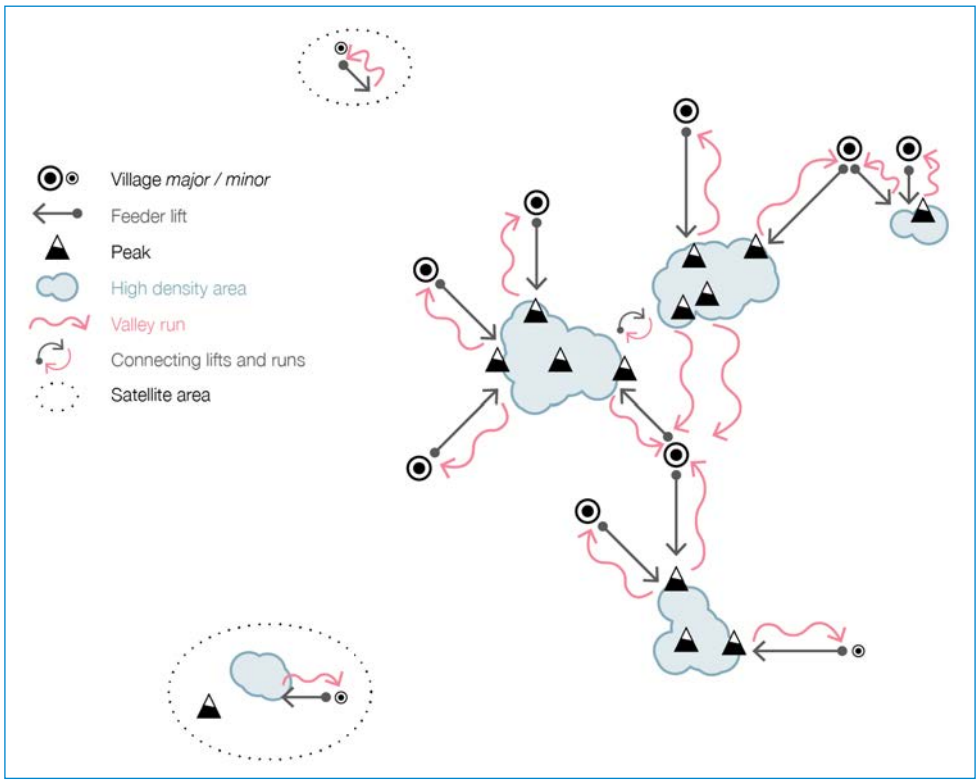

Figure 3.2: A mental map of SkiWelt.
Source: Janssen (2020)

Feeder lifts are usually cable cars or gondolas which start at the valley and take the skier to the peak, sometimes via an intermediate station located half-way up the mountain. These lifts serve as the gateways to the ski area. Upon leaving the peak station, the skier can traverse the adjoining area via shorter lifts and slopes, the latter often running parallel to one another or forking off to create a dense network of paths and intersections. These areas are referred to as *high density areas* where nearby slopes and lifts often remain visible, potentially providing visual spatial clues useful for wayfinding. For example, the area between the Hartkaiser, Brandstadl and Eiberg peaks can be considered such a high density area as a large number of lifts and slope are concentrated there. Figure 3.3 shows how this complex area is visualised on the official SkiWelt map.

3.2 Maps used as stimuli for the user evaluation

This study compares two depictions of the SkiWelt, the official panorama map and a planimetric, topographic map. The following will provide an in-depth review of both maps. The panorama map, referred to as Map A in the following, is the official map published and distributed by the SkiWelt Wilder Kaiser – Brixental Marketing GmbH. It may be argued that this type of depiction of a geographical area is not a map in the traditional sense as, for example, as defined by the School of Austrian Cartographers (Scharfe, 2002), due to the lack of characteristics typical of a map such as scale, georeferencing and, most importantly in this case, representation in the plane. The word *map* is, however, commonly used by ski resorts themselves and in common parlance among participants in winter sports activities. The panorama map of SkiWelt (Figure 3.4) can be viewed online as either an interactive map with real-time information about lift and slope status[4] or downloaded as a PDF[5]. The map is also available throughout the ski area as a folded print version and can be obtained free of charge at lift stations, tickets sales points and from many touristic business. Visitors to the ski area also encounter the map as a key part of large information boards at gateway points such as peak and valley lift stations. The latter are often used to identify one's location within the area and find slopes and lifts to plan a journey.

The winter panorama that forms the basis for Map A was hand painted by Innsbruck-based panorama artist Ingrid Schultus-Föger (Janssen, 2020). The artist used to work as a panorama artist for H. C. Berann and later for Berann's successor Heinz Vielkind before founding her own studio (Schultus-Föger, 2020). Stefan Grafl, a representative of the SkiWelt Wilder Kaiser – Brixental Marketing GmbH, describes the following steps as necessary to produce Map A (Janssen, 2020):"

1. Definition of the map type (for example orthophoto, painted type etc)
2. Definition of foci (which objects and facilities are to be shown)
3. Acquisition of infrastructure [information] through partners (lift operators, transit partners…)
4. Gathering of points [of interest] and adding [them to the map]
5. [Final] check and approval by partners."

An update of the printed map which includes a review of "all points" on the map is carried out on a semi-annual basis, while the digital version is subject to a continuous update process (Janssen, 2020). Grafl further describes the target audiences of the map as day skiers visiting the area, tourists from the surrounding tourism regions of Kufsteinerland, Wilder Kaiser, Kitzbüheler Alpen Brixental, Kitzbüheler Alpen Ferienregion Hohe Salve, paragliders as well as ski tourers who may use the lifts provided by cable car operators and cross country skier using the Höhenloipe Hochbrixen.

In this research, the panorama map and its affordances are compared against a planimetric map created by the author as part of the M.Sc. Cartography curriculum. The idea for an alternative map was conceived after a visit to the SkiWelt for a few days of skiing in January 2019 during which the author and her family struggled to find a quick descent back to the car park by using the panorama map. Time became a matter of importance after a family member experienced an allergic reaction and needed to return to the car to locate a pharmacy. Due to the perceived illegibility of the slopes and lifts where the author's family found themselves it took several wrong slopes and lifts before the cable car to the valley could be reached. It should be noted that being new to this ski area contributed to the lack of spatial awareness and the medical emergency compounded the situation. This experience of dissatisfaction with the map in the described emergency situation sparked the idea to create an alternative cartographic depiction of the ski area.

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[4] https://www.skiwelt.at/en/skiwelt-skimap.html

[5] https://media.skiwelt.at/de/skiwelt-winter-panorama.html

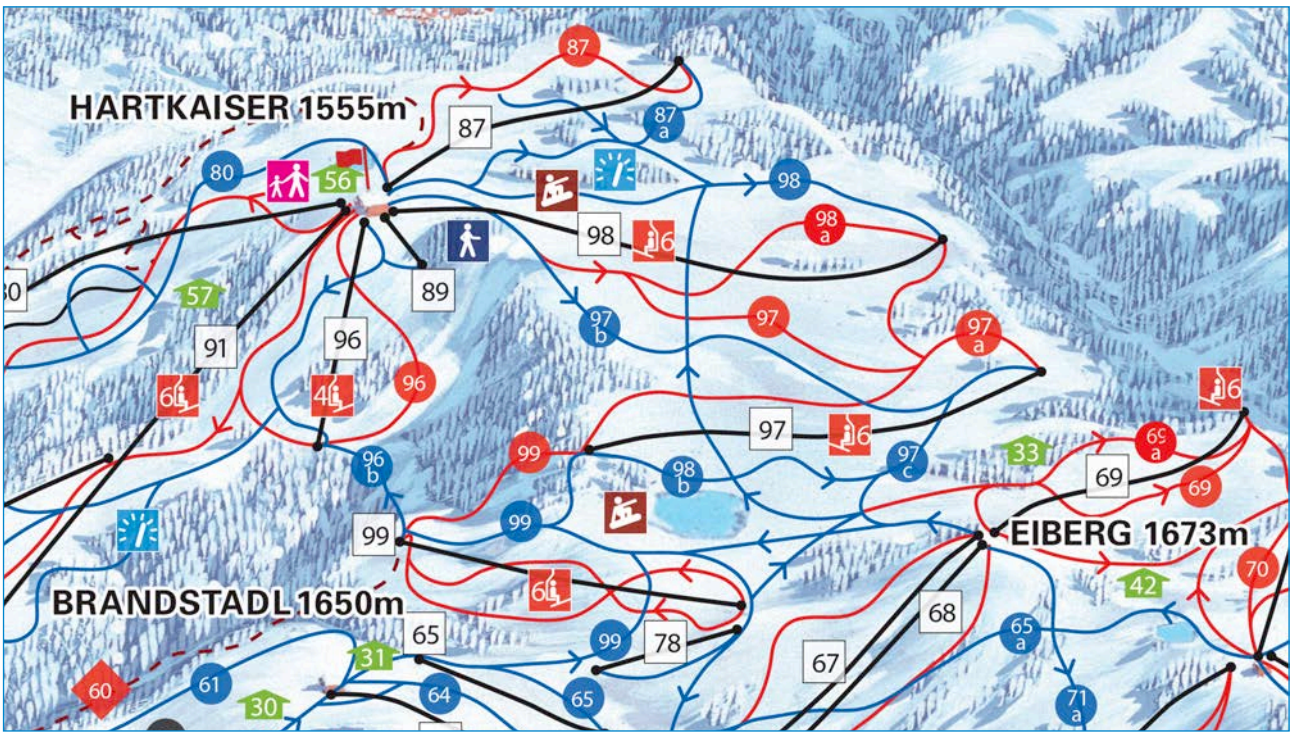

Figure 3.3: Detail of the official SkiWelt ski map.
Source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020)

Figure 3.4: Official map of SkiWelt Wilder Kaiser - Brixental.
Source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020)

The resulting map created by the author (Figure 3.5), referred to as Map B in the following, is a combination of a relief and planimetric map with planimetric geographic information such as slopes, lifts, buildings, roads and waterways overlaid onto a shade relief layer. Although the map does not contain contour lines to represent changes in terrain height it can be considered a topographic map as "the map reader [...] is able to measure locations, directions, distances and areas" (MacEachren and Taylor, 1994). The shade relief layer forms the basis of the topographic ski map over which map objects are laid as point, line and area features. At a scale of 1:40,000 the map shows roads, waterways, settlements, and winter sport infrastructure such as lifts and slopes. Due to the limited time available to complete the mapping project, certain content types that are shown on the panorama map were not considered for the topographic map including specific winter sport activity areas such as fun parks or toboggan runs.

In order to compare the content shown on Map A and Map B and how they are styled, visual map objects identified by Balzarini et al. (2015) after studying expert-artist and user-skier activities are used as a guide for this review. Table 3.1 provides an overview of the map objects present and the styles used to represent them. Brewer (2016) and Kent et al. (2018) amongst others have described various elements related to the overall map layout that help improve and support the main map. Whilst the contents or map objects are quite similar on both maps used for this study, the panorama map remains only a map-related depiction of the ski area as it is lacking most of the conventional

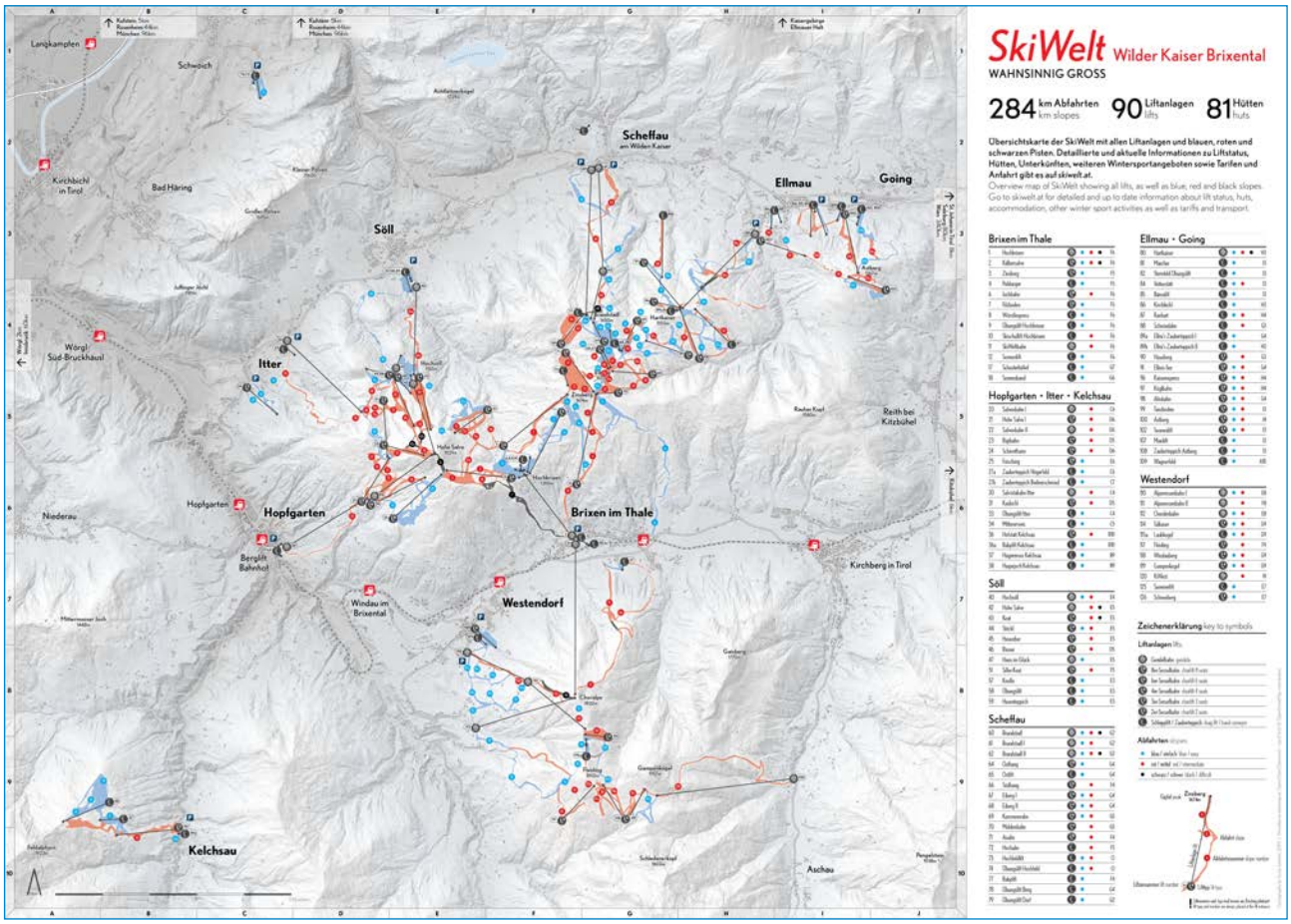

Figure 3.5: Planimetric map (Map B) of the SkiWelt created by the author as part of the M.Sc. Cartography. Source: Janssen (2019)

layout elements usually associated with a map, therefore limiting its use as a means through which the user may ascertain measurable and accurate information. The planimetric ski map contains several layout elements that help the user understand the map better as it is drawn to scale, an essential characteristic (Kohlstock, 2018), enabling the user to measure distances and area and

Table 3.1: Comparison of the map contents of Map A and Map B

Geographic objects	Map A (unedited)	Map B (unedited)
Ski area boundary	Not explicitly shown. Map boundary implies ski area extent.	Not explicitly shown. Map boundary implies ski area extent.
Sunlight exposure / shadows	“sham exposure (east/west)” *	Hillshading, lighting from north west
Focal point of the map	“centre of the picture” *	Not given due to parallel perspective
Perspective	Bird-eye view	Orthogonal
Geomorphological objects	**Map A (unedited)**	**Map B (unedited)**
Terrain	Painted	Presented through DEM hillshade layer
Peaks and ridges	Painted	Presented through DEM hillshade layer
Slopes	Painted	Presented through DEM hillshade layer
Corridors	Painted	Presented through DEM hillshade layer
Hollows, combes	Painted	Implied by the hillside layerPresented through DEM hillshade layer
Rocks, cliffs	Painted	Not shown
Trees	Individually painted	Not shown
Areas of snow and ice	Painted	Not explicitly shown, but the hypsometric tints aims to imply more snow as elevation increases
Paths	**Map A (unedited)**	**Map B (unedited)**
Slopes	Shown as curved lines, colour to indicate difficulty level	Shown as areas, colour coded to indicate difficulty level, based on OSM data
Lifts	Shown as lines, aim to “give realistic proportions and distances” *	Shown as lines, based on OSM data
Roads	Smaller roads painted, main arteries through the SkiWelt overlaid as generalised lines	Shown as lines, based on Open Data Österreich data
Waterways	Painted	Shown as lines, based on Open Data Österreich data
Train lines	Overlaid on to the panorama painting as generalised lines	Shown as lines, based on Open Data Österreich data
Structures	**Map A (unedited)**	**Map B (unedited)**
Settlements	Individually painted	Shown as individual buildings, based on Open Data Österreich data
Nomenclature	**Map A (unedited)**	**Map B (unedited)**
Names of the ski slopes	Shown as numbers contained in a circle, placed on the slope usually midway or near the start	Shown as numbers contained in a circle, placed on the slope usually midway or near the start
Names of the ski lifts	Shown as numbers contained in a square next to a square pictogram denoting the lift type, placed midway along the lift line	Shown as a pictogram containing the lift number and lift type, placed at the start of the lift
Peak names	Shown as text labels, include peak height	Shown as text labels, include peak height
Place names	Text labels, include elevation of settlements	Text labels, elevation not shown
Other points of interest	Pictograms used to denote parking, train lines, huts (each labelled with a number), ancillary winter sport activities such as fun park or time speed run	Pictograms used to denote car parking, train stations and huts

determine the length or width of a slope more accurately compared to Map A. Map B's distance grid and scale bar further help to determine distances. Although Map B is oriented north, an orientation indicator is shown on the map to confirm its orientation to the user. The panorama map also contains an orientation indicator, showing that the panorama is oriented toward the East (Figure 3.6).

Figure 3.6: Location (left) and detailed view (right) of the direction indicator on the panorama map.
Source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020)

Both maps are constructed in the same way with a raster layer of the painted panorama or processed digital terrain model forming the basis onto which map objects are overlaid (Figure 3.7). The map objects are made up of line, area, point and text features created as vector shapes. Each object has been assigned a visual variable. Established guidance on visual variables as described by Bertin (1967/1983 cited in Roth, 2017) and then later expanded by MacEachren (1995), and MacEachren et al. (2012) can be used to describe the meaning of the objects present on each map. In the case of alpine winter sport and skiing and snowboarding in particular, different hues of colour are often associated skill levels. Different slope gradients are associated with certain skill levels: beginner, intermediate and advanced. The assigned colours, blue, red and black respectively in the case of Europe, provide essential information to visitors of the ski area based on which lifts and slopes are chosen.

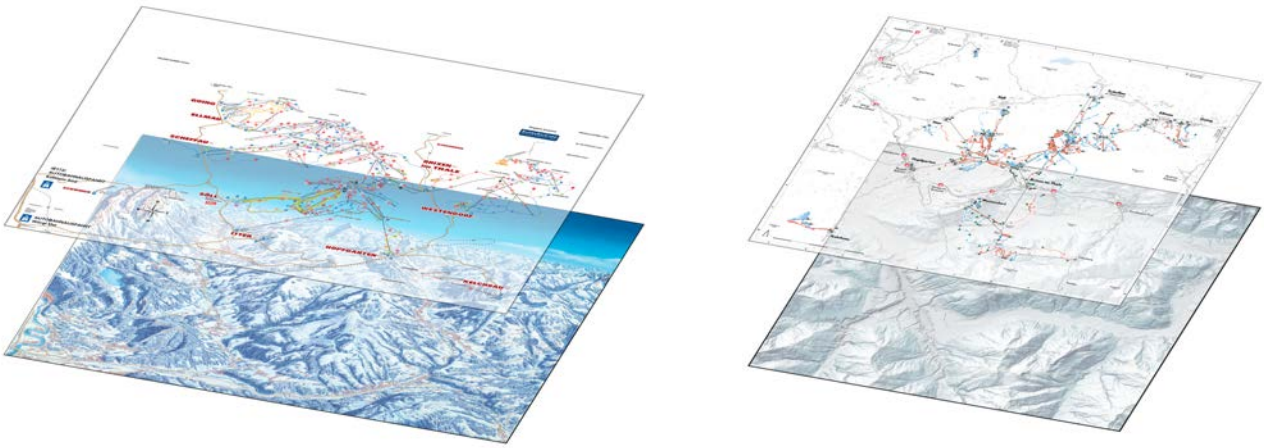

Figure 3.7: Raster and vector layers of Map A (left) and Map B (right).
Sources: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020) (left) and author (right)

Bertin (1967/1983 cited in Roth, 2017) considers colour hue an “associative” visual variable where every hue is “perceived with equal weight, allowing for the eye to perceive all map symbols with the same variation as a group”. This suggests that a ski map user would view the network of slopes as a whole before identifying the slopes with the colour hue that best suits their skill level. A beginner skier, for example, may focus on slopes depicted in blue. On both Map A and Map B colour hue is the dominant visual variable to describe the ski area in terms of the slopes it offers and the skill levels that it may appeal to. Other visual variables such as texture, colour saturation or size are not present.

Figure 3.8: Section of Map A showing the course of a slope. Source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020)

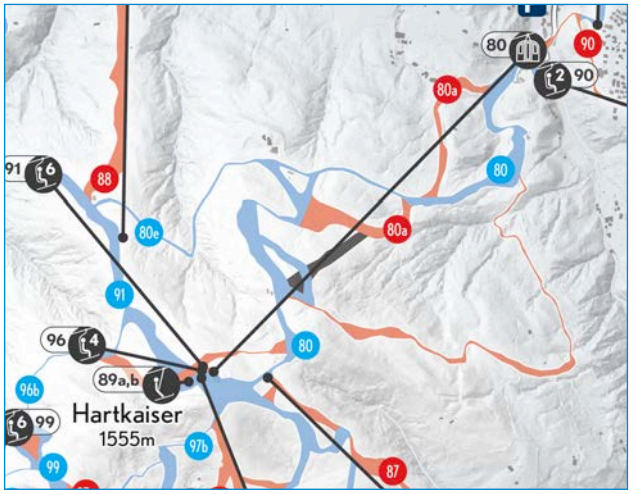

Figure 3.9: Section of Map B of the SkiWelt focusing on the slope areas.
Source: Janssen (2019)

Despite their shared approach of using the established colour scheme to denote slope types (ÖNORM S 4611) both describe them spatially differently. Map A shows each slope as single curved lines of equal width. The curves intend to visualise the approximate route of the slope across the terrain. How wide a slope might be at any point might be inferred by the area of snow painted. Equally, if the path of a slope seemingly goes across wooded areas in the painting, it might suggest a narrow slope going through a forest area (Figure 3.8). Map B shows the slopes as areas. Using Open Street Map data of the SkiWelt area retrieved in March 2019, a geo-referenced network of slope areas was created showing the actual spatial extent of the slopes. Each slope was assigned a colour hue according to its associated skill level (Figure 3.9). Another difference between Map A and Map B is in the approach to the labelling of lifts. Both maps use lines with rounded points capping off each end. On Map A the lines tend to be straight with some slightly curved lines to accentuate the shape of the terrain they are placed over. The pictograms depicting both the lift number and lift type are placed on the line and at its midpoint where space permits. Where space is limited, lift symbols may be placed towards the top of the lifts nearer to the lift exit or near the line. The two separate pictograms (number and type) are mainly placed in a specific order with the lift type (a red square containing a white lift symbol) first and the lift number (a white square with a black outline containing a black text) second. This order appears reversed in a few places. Small lifts such as drag lifts are only labelled with a lift number pictogram (Figure 3.8). For Map B the author decided to join both the lift number and lift type into one symbol instance in an attempt to reduce clutter. In order to help identify the lift entrance and direction the symbols are all placed at the beginning of each lift (Figure 9).

3.3 Preparatory map changes

In order to prepare the maps used as stimuli for inclusion in the online survey some preparatory map edits have been carried out to both maps. Table 3.2 provides an overview of the changes made. After having applied these edits both maps show the same level of content and are more comparable with each other.

Table 3.2: Preparatory map changes made to Map A and Map B

Map A (panorama map)
Removal of pictograms denoting ancillary winter sport activities such as fun park or toboggan run
Removal of indication of night skiing areas
Removal of ski routes
Map B (planimetric map)
Addition of mountain huts as shown on the panorama map
Update of lifts and slopes according to how they are names and categorised on the panorama
Adjustment of hypsometric tints of digital elevation model layer to accentuate the hill shading more and create more depth
Removal of lift reference table to the right of map. Replace text to be relevant to survey situation

3.4 Expert questionnaire

This study seeks to compare the usability of ski maps from a user's point of view. In order to also gain an understanding of the map provider's view the author approached the *SkiWelt Wilder Kaiser – Brixental Marketing GmbH*. The initial intention was to conduct an interview remotely over the internet due to the ongoing COVID-19 pandemic, however due to time constraints the format was changed to a written questionnaire. Stefan Grafl, a representative of the *SkiWelt Wilder Kaiser – Brixental Marketing GmbH*, who also answered the author's initial request for the use of the official SkiWelt ski map as part of this study, was very forthcoming in answering the questionnaire, providing an insight into how the map was produced and its objectives. The questionnaire (Appendix 9) contains several open-ended questions exploring themes related to the ski map including its production, design and contents, its purpose and target audience along with the distribution and availability and finally feedback, updates and future plans.

3.5 Online survey

The core of the primary research for this thesis consists of an online-survey through which participants evaluate either Map A or Map B. The questions and tasks contained in the survey correspond to the research objectives and research questions pertaining to the affordances of Map A and B within the context of assisting with wayfinding tasks, imparting geographic comprehension and eliciting emotional reaction (RQ1.1–RQ1.3), and questions related to user needs RQ2.1–2.2.

3.6 Survey structure, design and analysis

The survey is largely structured according to the aforementioned research questions. Following an introduction explaining the purpose of the survey and providing information related to data

protection and consent, participants are asked questions related to their gender, age, winter sport experience, skill level, and their familiarity with the case study area and ski maps in general. These questions contribute to the description of the random sample characteristics. Following those are sections related to user needs, navigation and orientation, geographic understanding and emotional response. Table 3.3 outlines the different survey sections and their purpose. The survey was set up to create two random samples by assigning a different stimulus, namely Map A or Map B to each participant. Apart from the different maps that participants encountered the remainder of the survey remains the same for all participants. A full outline of the survey structure and sequence of questions including filter questions can be found in Appendix 3. Screenshots of each final survey page as seen by the participants can be found in Appendix 4.

Table 3.3: Survey sections and their purpose

Demographic questions
Knowing the gender of participants
Knowing the age of participants
Winter sport and ski map experience
Gaining an understanding about the preferred alpine winter sport activity and skill level of participants
Gaining an understanding about the familiarity with the SkiWelt of participants
Gaining an understanding about the familiarity with panorama and planimetric maps of participants
Gaining an understanding about the awareness of ski map types and frequency of use of participants
User needs (RQ 2.1. and 2.2)
Understanding how important are particular ski map content types to participants
Understanding how important are particular supportive map elements to participants
Navigation and orientation (RQ 1.1)
Participants are asked to complete 3 navigation and orientation tasks of increasing complexity by using either Map A or Map B (the maps are assigned though a random stimuli generator)
Geographic understanding (RQ 1.2)
Participants are asked to complete 3 tasks which test their geographic understanding of the area based on the map they are assigned
Emotional response (RQ 1.3)
Participants are asked to assess emotional statements related to the map that they have been assigned

The design of the survey follows a mixed-methods approach, which incorporates qualitative and quantitative data collection methods. Qualitative methods such as open answer questions related to describing the difficulties experienced in completing a navigation and orientation task provide a nuanced insight into potential shortcomings of the maps from the participants' perspective, while quantitative data derived from selection or Likert scale questions create measurable data that allow for easy comparison of the results of both sample groups. Survey participants are presented with a variety of question types including single choice questions: "Which alpine winter sport do you preferably do?"; Likert scale questions related to participants' level of agreement; "Does the map help you understand the geography of the SkiWelt?"; and Likert-type scale questions relating to participants familiarity ("How familiar are you with the SkiWelt?), frequency of use ("How often do you use these different map types when out on the slopes?"), importance ("How important is it that a ski map shows the following information?") and difficulty ("How easy or difficult was it to answer this question?"). Participants are able to choose from five response anchors for questions related to level

of agreement (strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, strongly agree), familiarity (not familiar, slightly familiar, moderately familiar, quite familiar, completely familiar), frequency of use (never, almost never, sometimes, almost every time, every time) and importance (not at all important, slightly important, neither/nor, quite important, extremely important). A four point scale was used for questions related to rating the ease or difficulty with which participants completed the navigation and orientation tasks. Here, the decision to avoid the option of a mid-point, thus creating a 4-point forced choice" (Nadler et al., 2015), was made deliberately in order to compel participants to decide whether completing the task was either difficult or easy rather than choose something like neither/nor. Chosen in order to avoid ambivalence, this approach meant that all participants could then be either directed to or skip the following question which asked them to describe the difficulties they had.

Table 3.4: User needs question items

Map content	Supportive map layout elements
Slope difficulty level	Legend / key to symbols
Slope downhill direction	Orientation indicator such as a north arrow
Slope width	Scale indicator such as a scale bar
Geographically correct course of slopes	Lines of latitude and longitude (graticule)
Lift type	
Lift capacity	
Lift entrance	
Lift direction	
Ground transportation routes and stops between valley stations (such as a Skibus service that is included in the ski tariff)	

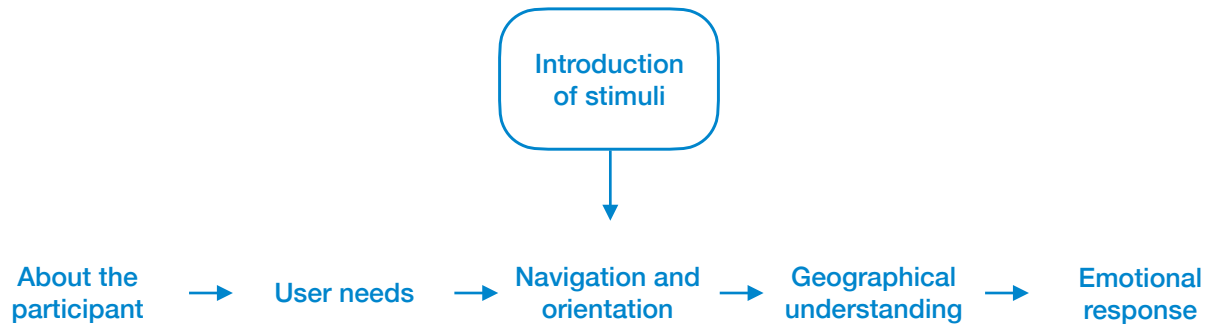

Figure 3.10: Introduction of stimuli during the survey

Participants were only introduced to the stimuli, Map A or Map B, after answering questions about themselves and the needs they may have in relation to ski map content in general (Figure 3.10). The reason for this is to gain their user needs without having seen one of the maps and therefore potentially developed a bias towards a certain map type and associated contents and graphic styles. The survey section about users' needs contained two separate questions (Table 3.4), one asking the level of importance of certain map information specific to alpine winter sports, and

the second related to more general map layout elements that may aid the user's geographical understanding of the mapped area. Whilst traditional ski maps such as Map A usually contain content types such as slope difficulty level, downhill direction in certain ambiguous areas, lift type and capacity as well as ground transportation links that can be accessed as part of the ski area tariff, this type of map does not explicitly show the width of slopes or the geographically course of slopes. An alternative ski map type such as Map B shows actual slope widths and the geographically correct course of the slopes.

The section related to navigation and orientation was comprised of three tasks, each asking participants to identify a connection between two points of interest (POIs hereafter) on the given map and listing the lifts and/or slopes they would take to get from one POI to the other. The tasks increased in complexity in order to test different areas of each map, with Task 1 being the least complex and Task 3 the most complex in terms of the number of lifts and slopes required to connect the two POIs. In each case, the most direct connection is most desirable. The following provides an overview of the characteristics of each task.

Task 1 question: Using lifts and/or slopes, how would you get from Söll to Hohe Salve?

The first task asked participants to find the most direct route between the village of Söll and the Hohe Salve peak. It is the least complex task as only two lifts are required to reach Hohe Salve from one of the car parks in the village, namely the gondolas 40 and 42. Figure 3.11 shows how the route is visualised on Map A and Map B.

Task 2 question: Using lifts and/or slopes, how would you get from Westendorf to Fleiding?

The second task asked participants to find the most direct direction between the village of Westendorf and the Fleiding peak. In addition to the two gondolas 110 and 111 the most direct route further includes slopes 111 and 117 or 117a followed by a final ascent via chair lift 117. Figure 3.12 shows how the route is visualised on Map A and Map B.

Task 3 question: Using lifts and/or slopes, how would you get from Brandstadl to hut 4?

The third and final navigation and orientation task asked participants to find the most direct direction between the Brandstadl peak and hut 4 (Gasthof Holzalm). This most complex task starts with a descent down slope 64 to reach chair lifts 67 and 68. As both run parallel either can be used to reach the Eiberg peak from which slope 70a leads to chair lift 70 which in turn travels up to the Zinsberg peak. From there, slope 2a continues on to hut 4. Figure 3.13 shows how the route is visualised on Map A and Map B.

The answers to each question by each participant are assessed in terms of whether they have found the most direct way, found a way but via a different course or not made the connection at all. Assigning a numerical value to each, 1, 2 and 3 respectively, will create quantitative results with which the performance of both groups can be compared statistically.

Following each navigation and orientation question, participants were asked to rate the level of difficulty with which they answered completed the task. A rating of either very difficult or somewhat difficult leads to a further question asking for a brief description of the difficulties encountered. The descriptions of the difficulties experienced by participants provide qualitative data, which helps to identify any particular issues of the maps. Rating the task as either very easy or somewhat easy would skip the aforementioned question.

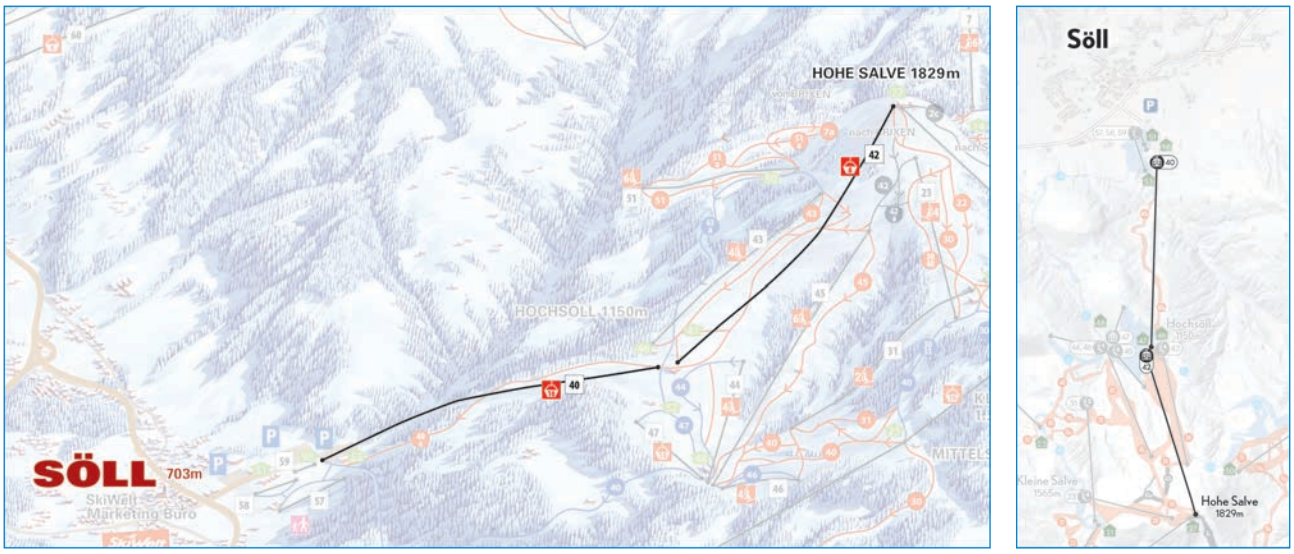

Figure 3.11: Connection between Söll and Hohe Salve on Map A (left) and Map B (right).
Sources: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020) (left) and Janssen (2020) (right)

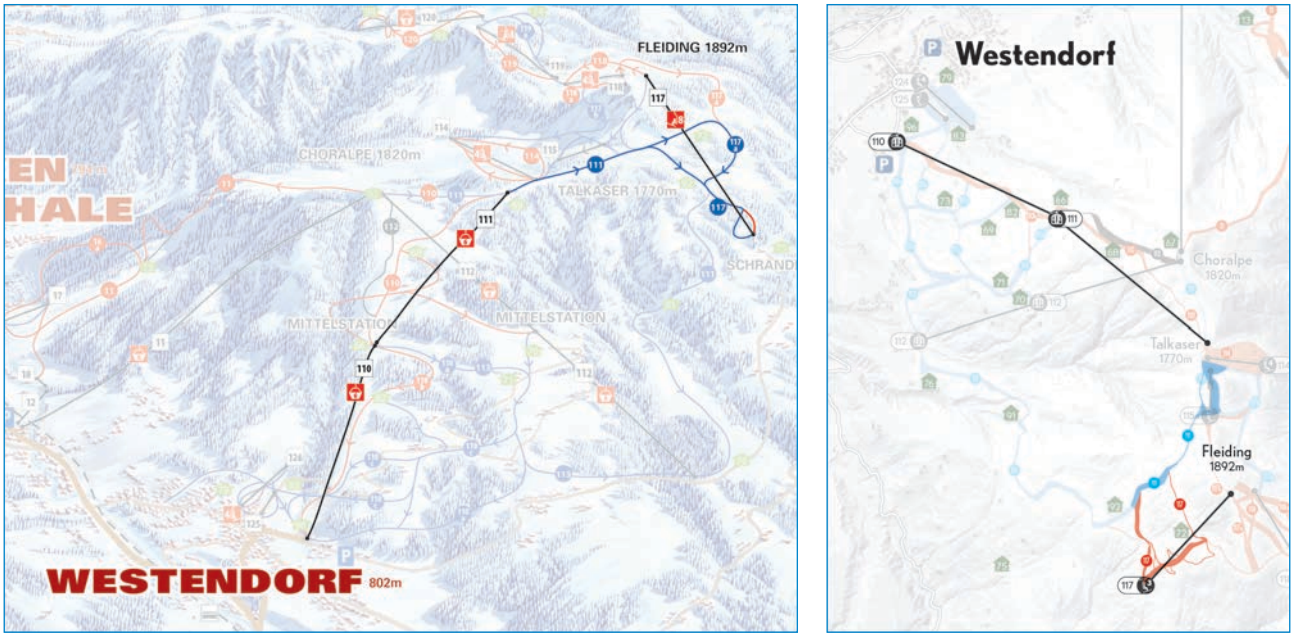

Figure 3.12: Connection between Westendorf and Fleiding on Map A (left) and Map B (right).
Sources: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020) (left) and Janssen (2020) (right)

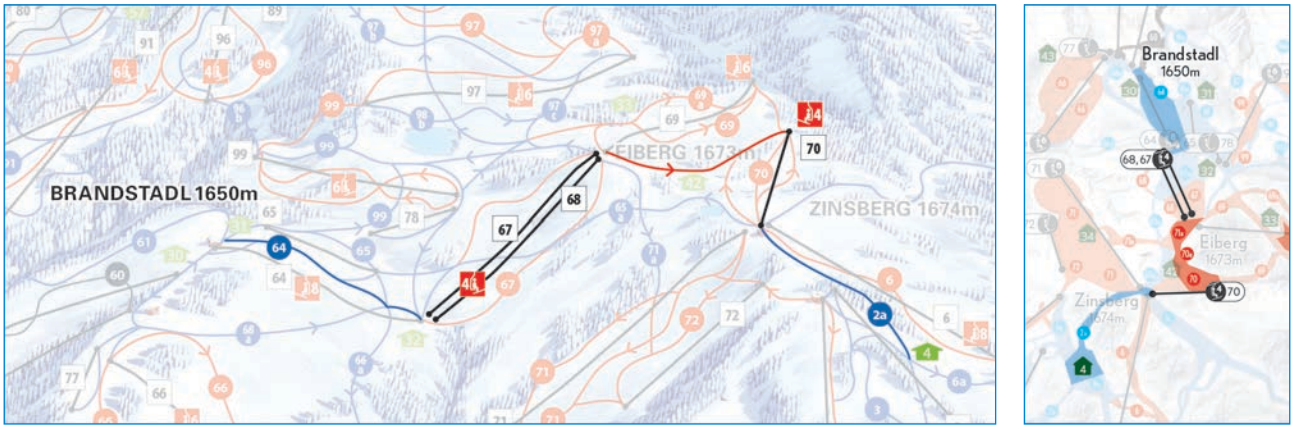

Figure 3.13: Connection between Brandstadl and hut 4 on Map A (left) and Map B (right).
Sources: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020) (left) and Jenny Janssen (2020) (right)

In addition to questions related to navigation and orientation, the survey included three tasks testing the participants' geographical understanding. In this section participants were asked to say whether the following statements are true or false:

- Going is located north of Scheffau.
- Brixen im Thale is located east of Hopfgarten.
- Hopfgarten is located east of Itter.

Given that traditional ski maps such as Map A are not necessarily drawn North up, it cannot be assumed that it is clear to a user which way the map is facing and how POIs on the map are spatially related to each other. With Map A facing East and Map B facing North, but both containing a compass and north arrow respectively as direction indicators, this task sought to understand how both sample groups would perform in relation to understanding the ski area's geography. Each answer given by participants' will be assigned a value, 1 for correctly and 2 for incorrectly answered, quantifying the performance of both sample groups. Furthermore, a Likert scale question asked the participants whether they agree to statements about the maps' ability to help understand the geography of the SkiWelt (Table 3.5).

Table 3.5: Statements related to the geographical understanding of the SkiWelt

Does the map help you understand the geography of the SkiWelt?
The map gives a good impression of how steep the slopes are.
The map gives a good impression of how wide the slopes are.
The map gives a good impression of how long the slopes are.
This map enables to judge distances.
The map enables to judge the terrain of the SkiWelt and identify particularly steep and flat areas.
The map provides a good overall geographical understanding of the SkiWelt.

The final section of the survey asks participants to state the level of agreement with four statements about the map they are seeing. The statements relate to the emotions curiosity, excitement, certainty and confidence. Table 3.6 provides and overview of the statements. The quantitative results from these two sections allow for the comparison of the two groups.

Table 3.6: Emotional statements related to Map A and Map of the SkiWelt

How do you feel about this map with regards to the impression it gives about the SkiWelt as a winter sports destination?
Curiosity: This map makes me curious about the SkiWelt and what it has to offer for winter sports.
Excitement: This map gets me excited about the SkiWelt as a winter sport destination I want to spend time at.The map gives a good impression of how wide the slopes are.
Certainty: This map enables me to judge the terrain and slope characteristics and provides me with a sense of certainty when choosing a slope.
Confidence: This ski map gives me confidence that I can navigate and orient myself when I am in the SkiWelt.

Descriptive data analysis methods are used to analyse and present the raw quantitative data obtained from the survey. Results will be visualised as bar charts representing results from one sample group at a time or stacked bar charts though which responses from both groups can be viewed at the same time. Mean values and measures of distribution including deviation and variance are used to apply the T-test to some of the results to indicate whether the maps as variables may have had a significant impact on the results.

3.7 Survey distribution

The link to the online survey[6] was distributed through social media channels and shared among the author's own private and professional network over the course of 30 days from 2nd of July to 31st of July 2020. The social media channels used included Instagram, Facebook and LinkedIn. Whilst the survey was started 168 times only 85 participants progressed through to completion, and only these are considered valid for the evaluation. Of the valid cases 36.5% and 63.5% came from social media channels and the author's private and professional network respectively. The survey was designed and distributed in English and German with 69.4% of the valid cases having completed the English and 30.6% the German version.

6 https://www.soscisurvey.de/skimaps/

4. Results and discussion

In order to address the research questions for this thesis participants taking part in the online survey (Appendices 3 and 4) were asked to respond to questions and tasks related to user needs, navigation and orientation, geographic understanding and their emotional response using either Map A or Map B. The following provides an overview of the quantitative and qualitative results obtained from these survey questions and tasks. Furthermore, the results and their implications for both Map A and B will be discussed.

4.1 Description of the random sample groups

The following provides an overview of the characteristics of both random sample groups, sample group A having seen Map A and sample group B having seen Map B. Out of the valid 85 cases 48 participants saw Map A and 37 participants saw Map B, creating a larger sample size for Group A (Figure 4.1).

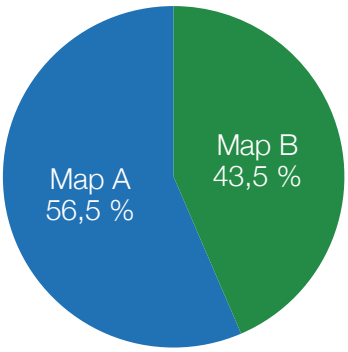

Figure 4.1: Distribution of stimuli to Group A and B

The gender distribution of Group A and B are very similar (Figure 4.2).Both groups have more male participants than female.

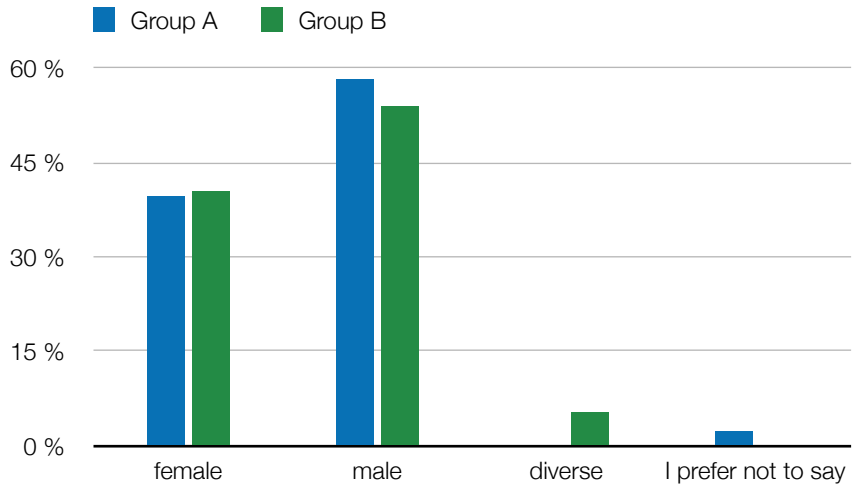

Figure 4.2: Gender distribution of Group A and B

Although some degree of variation is seen in the 35-44 year and 45-54 year ranges (Figure 4.3), the mean average age of both groups is 39 years, while the median average of both groups is similar at 34 for Group A and 33 for Group B. For both groups the youngest participant was 20; for Group A the oldest was 76 and for Group B the oldest 78.

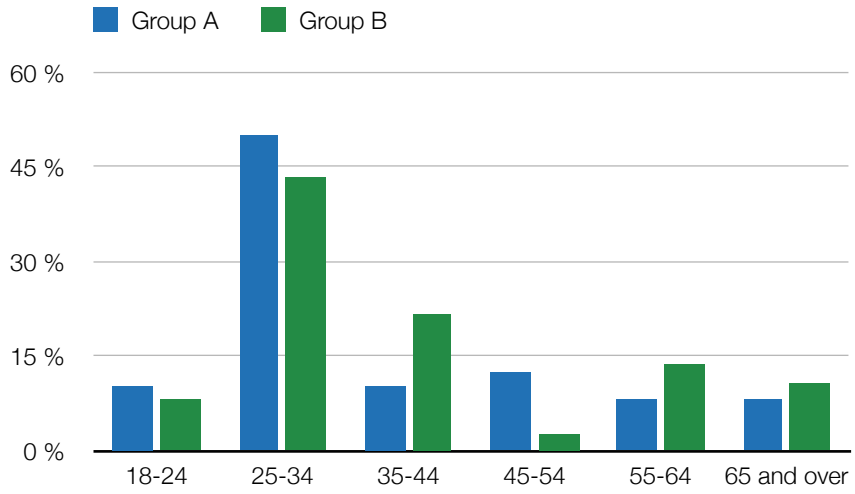

Figure 4.3: Age distribution of Group A and B

For the majority of participants alpine/downhill skiing was the preferred winter sport activity (Figure 4.4). The percentage of participants who chose snowboarding as their preferred activity was similar in both groups. The percentage of participants who chose ski touring was notably different between the two groups. Ski tourers tend to ascend on foot rather than taking ski-lifts; this inherent difference in the way that this group navigate ski areas may influence the results of the map evaluation. There is also a notable difference in the number of cross-country skiers between the two groups; this pursuit normally involves using a different kind of map specific to that sport, and so these participants may have a lower level of familiarity with Map A. 27.1% of Group A and 18.9% of Group B did not engage in alpine winter sports.

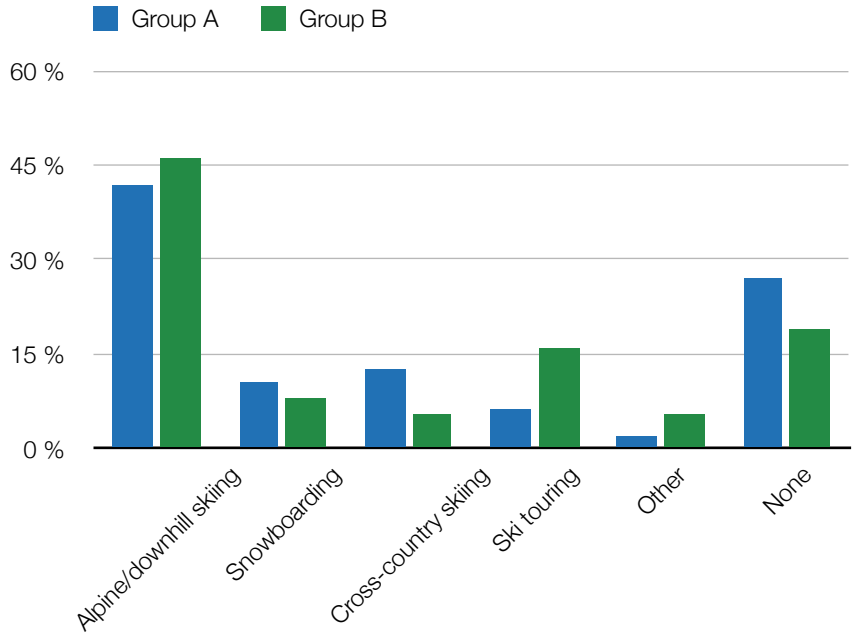

Figure 4.4: Preferred winter sport activity of Group A and B

The majority of participants in both groups stated their skill level in their preferred alpine winter sport activity as intermediate (Figure 4.5). In group B 27% selected advanced compared to 8.3% in Group A, suggesting the overall level of expertise is somewhat higher in Group B than Group A.

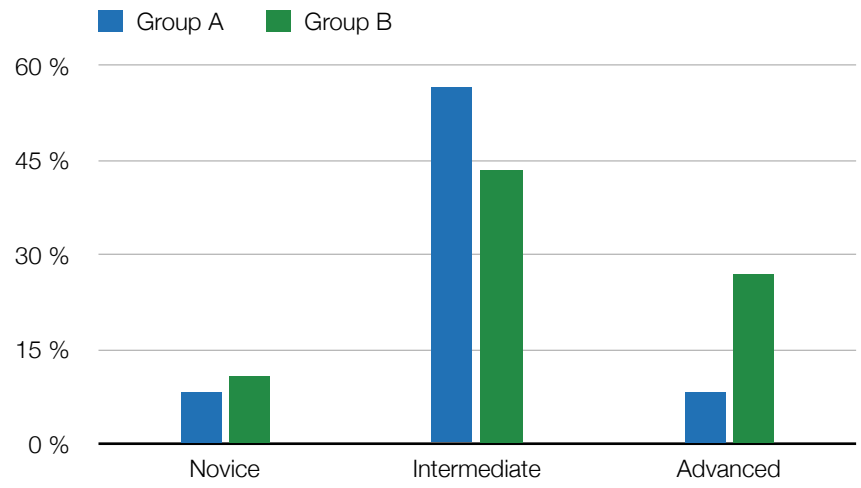

Figure 4.5: Skill levels of preferred winter sports of Group A and B

The level of familiarity with the SkiWelt Wilder Kaiser - Brixental is overall very low (Figure 4.6) with 85.4% in Group A and 78.4% in Group B being unfamiliar with the ski area.

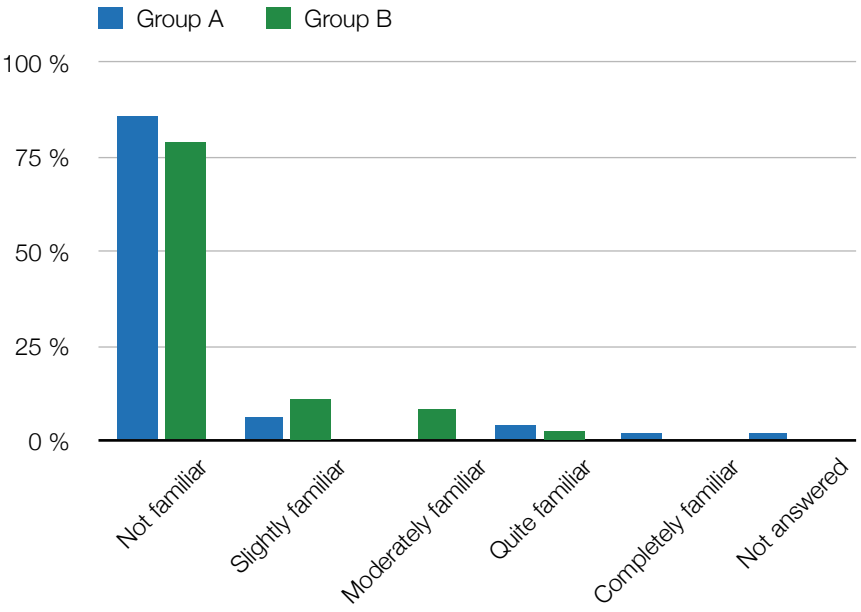

Figure 4.6: Levels of familiarity with SkiWelt Group A and B

The level of familiarity with both ski panorama (Figure 4.7) and planimetric maps (Figure 4.8) is notably greater in Group B than in Group A. This difference may influence results of the map evaluation.

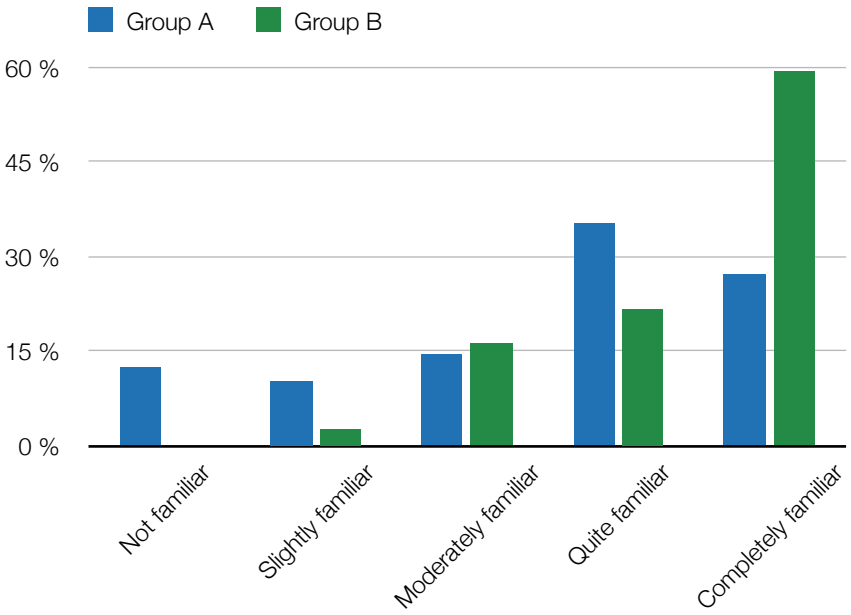

Figure 4.7: Levels of familiarity with ski panorama maps of Group A and B

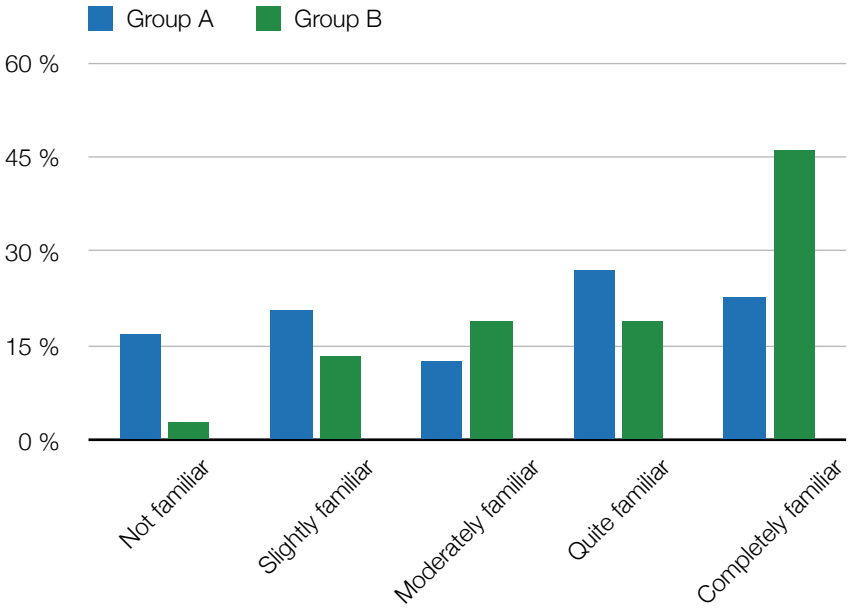

Figure 4.8: Levels of familiarity with planimetric maps using hillshading to visualise the terrain of groups A and B

The frequency of use of the large static ski map and printed ski map are highly similar in Group A (Figure 4.9) and Group B (Figure 4.10). In both groups the large static ski map is used most often closely followed by the printed ski map. The level of use of the PDF map and digital, interactive map is similarly low for both groups.

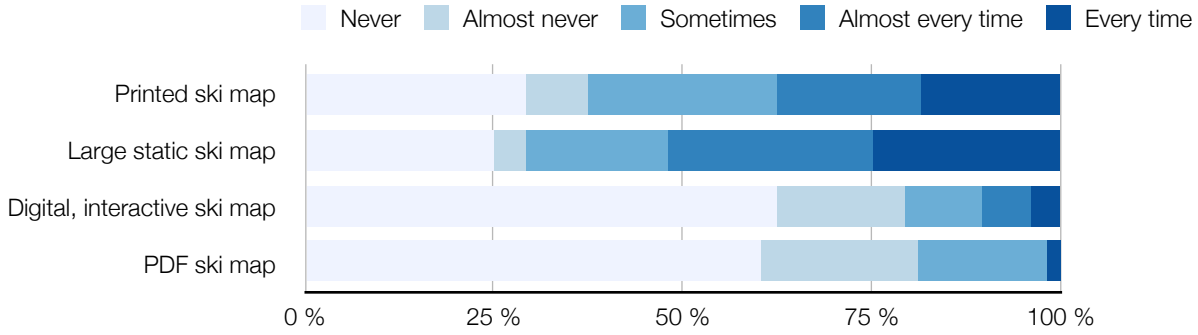

Figure 4.9: Frequencies of use of ski maps for Group A

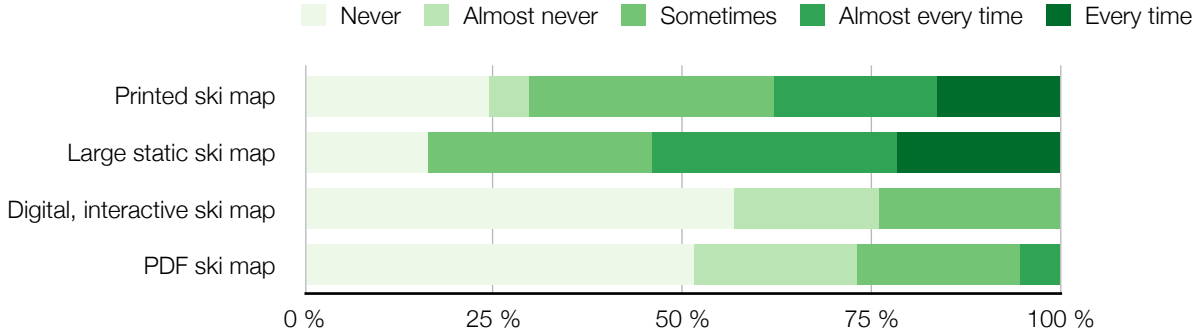

Figure 4.10: Frequencies of use of ski maps for Group B

4.2 User needs

Prior to being introduced to either stimuli, participants were asked to assign a level of importance to map elements that would help them carry out wayfinding tasks and understand the geography of an alpine ski area, thereby addressing research questions 2.1 and 2.2 respectively. The first question asked participants how they would rate the importance of certain information a ski map may provide. Aside from slope difficult levels and lifts type and capacity, the information types put forward largely related to spatial information such as the direction, width and course of slopes as well as the direction and entrance of lifts. Ground transportation between villages and their feeder lifts was also seen as a map element potentially helping improve wayfinding tasks.

68.8% and 70.3% of participants in Group A (Figure 4.11) and B (Figure 4.12) respectively feel that indicating the difficulty levels of slopes on a ski map is extremely important. A further 25% and 21.6% respectively find slope difficult level quite important. Only 6.3% in Group A and 2.7% indicate that this information is not at all important. 25% and 29.7% of participants in Group A and B respectively state that showing the downhill direction of slopes is extremely important compared to 37.5% and 51.4% who feel it is only quite important. Information about lift capacity was seen as least important in both Group A and Group B with a respective mean value of 2.8 and 2.6.

The second user needs question relates to layout elements of a ski map that afford users a better geographic understanding of the area. Prior to being introduced to either stimuli the majority of participants of Group A (Figure 4.13) and Group B (Figure 4.14) state that having a map legend is either quite important (37.5% and 43.2%) or extremely important (56.3% and 43.2%). The levels of importance assigned to an orientation indicator, scale indicator and graticule are similar across both groups. Following the legend an orientation indicator such as a north arrow and a scale indicator such as a scale bar are seen as second and third most important. The graticule is seen as least important, trailing the other map elements notably as 60.4% of Group A and 56.8% of Group B feel it is not at all important.

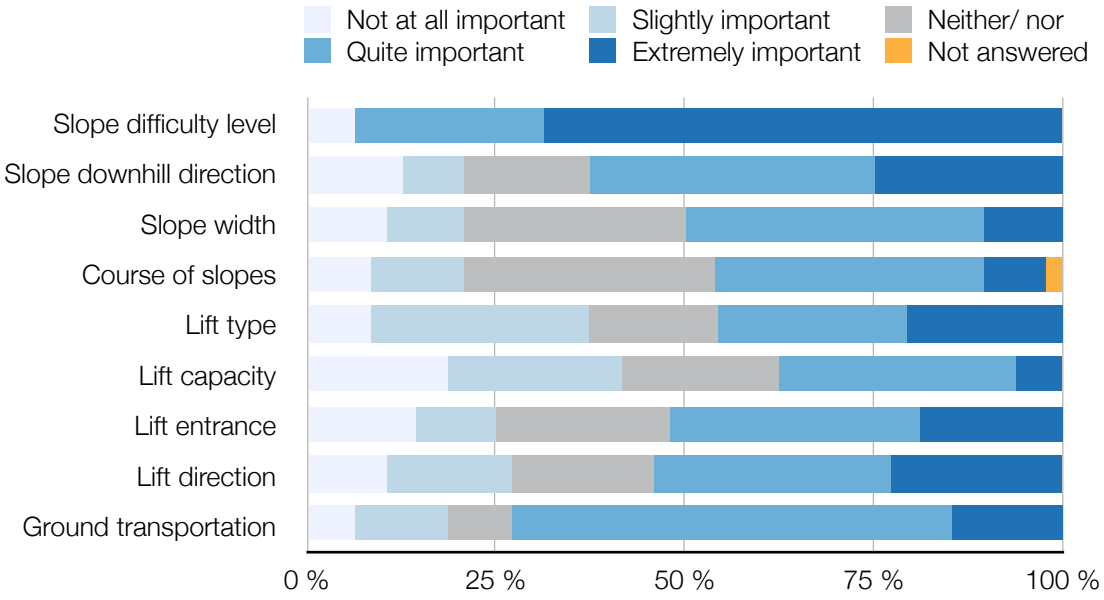

Figure 4.11: Importance of map contents to Group A

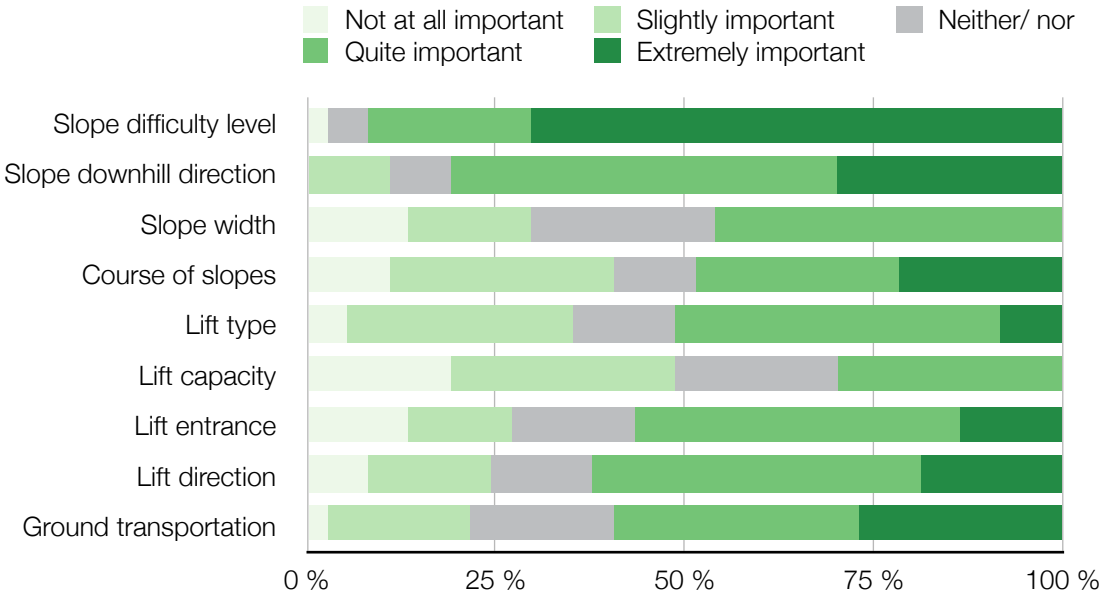

Figure 4.12: Importance of map contents to Group B

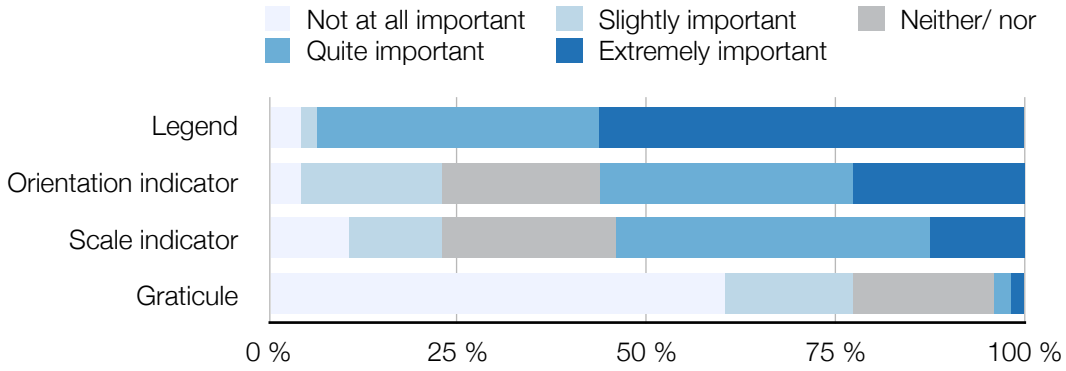

Figure 4.13: Importance of map layout elements to Group A

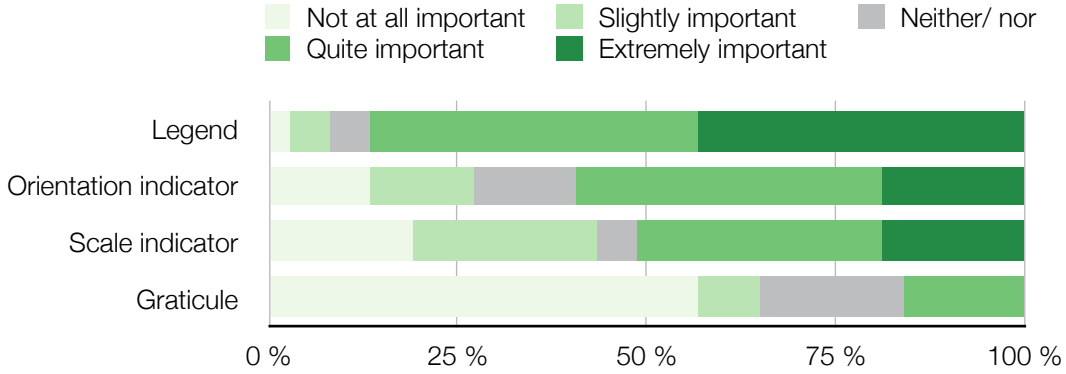

Figure 4.14: Importance of map layout elements to Group B

4.3 Navigation and orientation tasks

To complete the navigation and orientation tasks participants of Group A were given Map A (panorama map of the SkiWelt Wilder Kaiser - Brixental; see Appendix 1), whilst participants of Group B received Map B (a planimetric map depiction of the same area; see Appendix 2). The first task asked participants of both groups to use their respective map to find a connection from Söll to Hohe Salve using lifts and/or slopes. 93.8% of Group B found the correct connection, gondolas 40 and 42, compared to 74.4% of Group A (Figure 4.15). More participants of Group A did not find the correct connection between the village and peak than did in Group B. Similarly more participants in Group A than in Group B choice a varied connection by mentioning additional lifts and slopes to connect Söll and Hohe Salve.

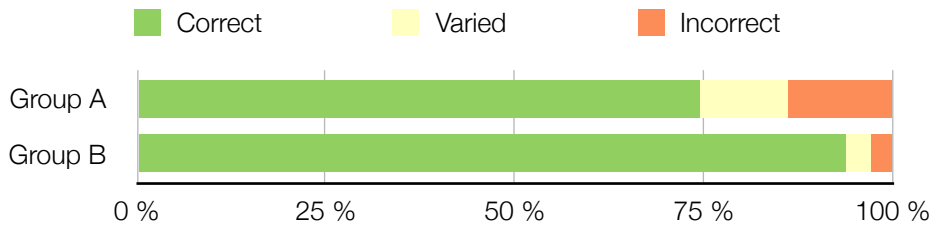

Figure 4.15: Completion of task 1

Mirroring the overall results are the responses to the question of how difficult it was to complete the task. Only 2.3% in Group A and 3.1% in Group B found the task very difficult (Figure 4.16). However 32.6% and 12.5% found it somewhat difficult in Group A and B respectively.

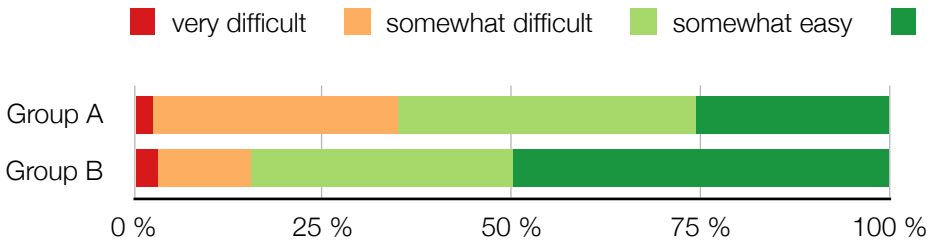

Figure 4.16: Level of difficulty of completion of task 1

A range of difficulties were encountered and mentioned by participants of both Group A and Group B (Appendices 5 to 8). During this first task participants of Group A largely expressed difficulties with the legend of Map A which was only provided in German an oversight the author only realised after the reviewing the qualitative results. Apart from a potential language barrier, participants also noted confusion about the symbols and colours used the legend: “legend unclear - why red symbols for lift type when sessellift is black? esp if there is a red line for a ski route”. Aside form this, the naming of lifts and slopes was mentioned second most by participants using Map A, followed by the difficulty to make connection between slopes and lifts. The latter reflecting a particular problem relating to the area of Söll around the bottom of the feeder lift 40 (Figure 4.17) where a number of small lifts and slopes, also known as baby lifts for children and absolute beginners, are between the village and the beginning of lift 40. One participant for example wondered if they “need to take several small lifts from Söll to get to the bottom of Lift 40?” One participant of Group A expressed a similar sentiment in relation to understanding of how to connect to the lifts this by stating: “not sure where you can walk on the map/where you have to ski/take lifts”. Difficulties expressed by participants of Group B in relation to task 1 largely focused on the direction of the lifts and slopes shown on Map B not being clear: “determining which part of the slope was the highest and the lowest” as being a problem. Furthermore, participants of Group B struggled to locate the destination on the map which they had to find a connection between.

Figure 4.17: Söll area of baby lifts and gondola 40 as shown on Map A (left) and Map B (right). Sources: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020) (left) and author (right)

Task 2, “using lifts and/or slopes, how would you get from Westendorf to Fleiding?”, was more complex compared to the previous task. 76.2% of Group A correctly selected lifts 110,111, blue slopes 111, 117 or 117a and lift 117 to be the most direct connection between Westendorf and Fielding as supposed to only 20.6% of Group B (Figure 4.18). One participant in each group (2.4% and 2.9% respectively) suggested a different and varied route. Despite the disparity in correct answers between the two groups, the results for Group A and B are very similar for the question of how difficult it was to complete this task (Figure 4.19). Participants of Group A are split halfway with 50% finding it either somewhat easy (47.6%) or very easy (2.4%) and 50% finding it either somewhat difficult (42.9%) or very difficult (7.1%). Group B shows a similar trend, albeit it with slightly higher results at either extreme end of the scale. Overall, 52.9% participants of Group B decided that the task was either somewhat easy (47.1%) or very easy (5.9%), making this group appear slightly more confident with regards to completing it.

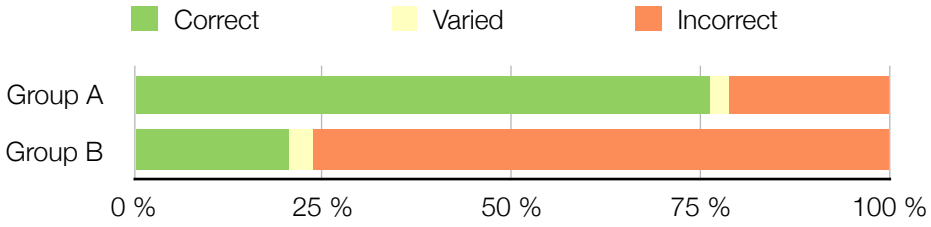

Figure 4.18: Completion of task 2

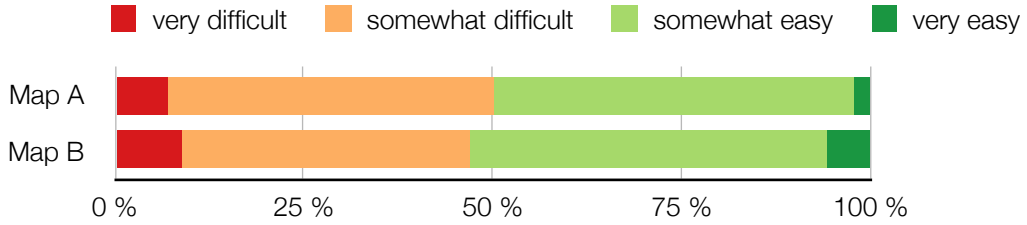

Figure 4.19: Level of difficulty of completion of task 2

Looking at the types of difficulties that participants of Group B experienced, the complexity of the map was mentioned the most along with some participants’ inability to make connections between lifts and slopes and finding the destination to begin with. Identifying the direction of slopes and lift was only mentioned to a notable degree. Despite these struggles Group B has a considerably higher rate of correct answers than Group B (Figure 4.18). The results from this task reveal a notable flaw with Map B which relies on hill shading to communicate the terrain of the ski area. It may be assumed that participants of group B felt they had find the right connection between the village in peak and therefore stated that the completion of the task was relatively easy. However, a closer look at the task answers suggests that the terrain was misunderstood in some areas of Map B. Figure 4.20 provides a closer look at how the area between the top of lift 111 and Fleiding is visualised on Map A and Map B. Even though the network of slopes criss-crossing the area appears dense and complicated to follow on Map A the application of direction arrows to the the lines denoting the slopes helps work out the slope directions. On Map B however, the user must rely on their understanding of the hillshading in order to determine the slope direction. Particularly the north-south connection between Talkaser and Fleiding is not very clear if only the terrain is considered. Connection stated by some participants of Group B include taking lift 115a under the assumption that it ascends from Talkaser to Fleiding. The placement of the Fleiding label may contribute to the ambiguity of the terrain in this particular area of the SkiWelt. Adding means to indicate the direction of lifts and slopes may improve navigation and orientation here.

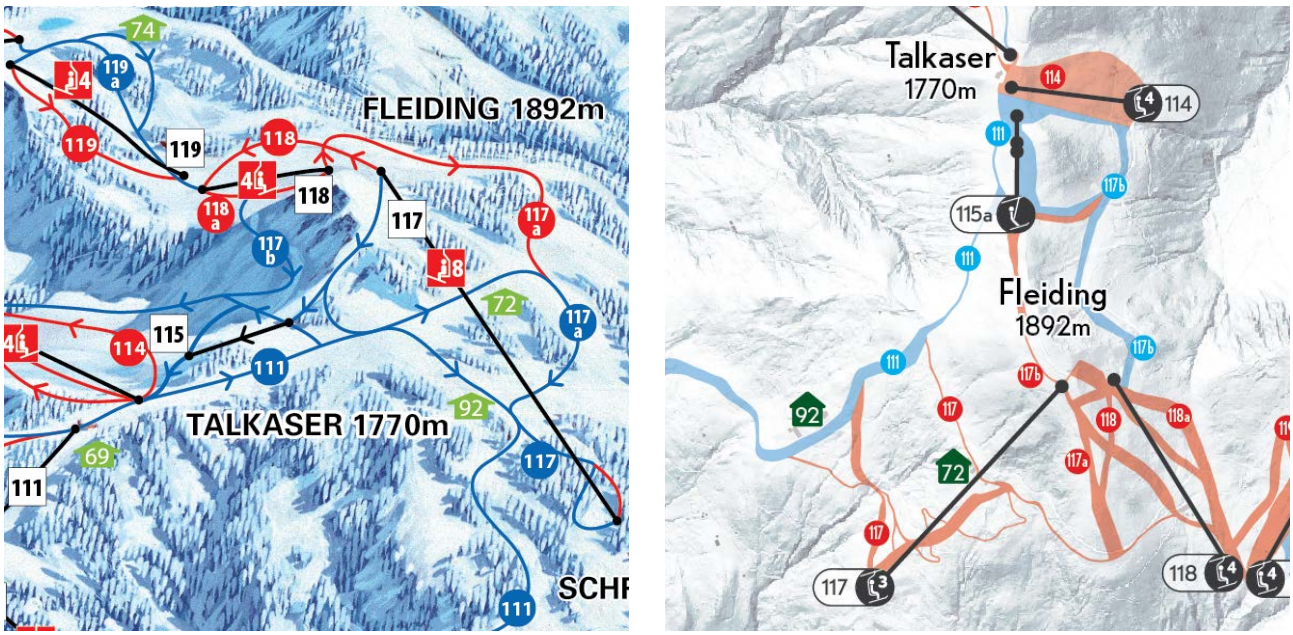

Figure 4.20: Area around Fleiding peak as shown on Map A (left) and Map B (right).
Sources: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020) (left) and author (right)

Task 3, the most complex of the navigation and orientation tasks, asked participants of Group A and Group B how to get from Brandstadl to hut 4. In both groups the majority of participants did not name the desired slopes and lifts to connect the peak with the hut (Figure 4.21). Only 13.9% of participants of Group A found the correct route, whereas 30.9% of the same group chose a varied route to connect Brandstadl and hut 4. For Group B the results were even lower with 9.4% and 25% respectively. Following the completion of the task participants were asked to rate their level of difficulty (Figure 4.22).

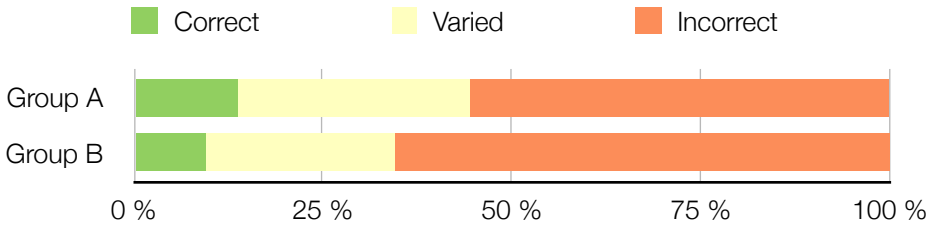

Figure 4.21: Completion of task 3

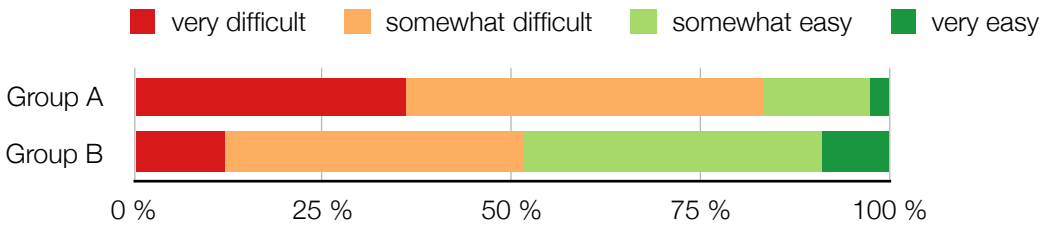

Figure 4.22: Level of difficulty of completion of task 3

The results for Group B are similar to the results for task 2 with about half the participants of that group finding the task either somewhat easy (39.4%) or very easy (9.1%) leaving 51.5% finding it somewhat difficult (39.4% or very difficult (12.1%). In contrast, the clear majority of participants in group A stated that the task was very difficult (36.1%) or somewhat difficult (47.2%) to complete, with only 13.9% and 2.8% finding it somewhat easy and very easy respectively.

The difficulty mentioned most often by participants in Group A was the high complexity resulting illegibility of Map A (Appendix 8). Struggling to find the destinations that needed to be connected was also an issue mentioned often alongside the difficulty to make connections between lifts and slopes. The lack of a particular slope labels also cause some confusion as well as the directions of slopes and lifts not always being clear. Participants in Group B (Appendix 8), mentioned the inability to work out the direction of slopes and lifts most often, followed by the Map A's level of complexity and not understanding the terrain. Figure 4.23 shows the area between Brandstadl and Eiberg as seen on Map A and B.

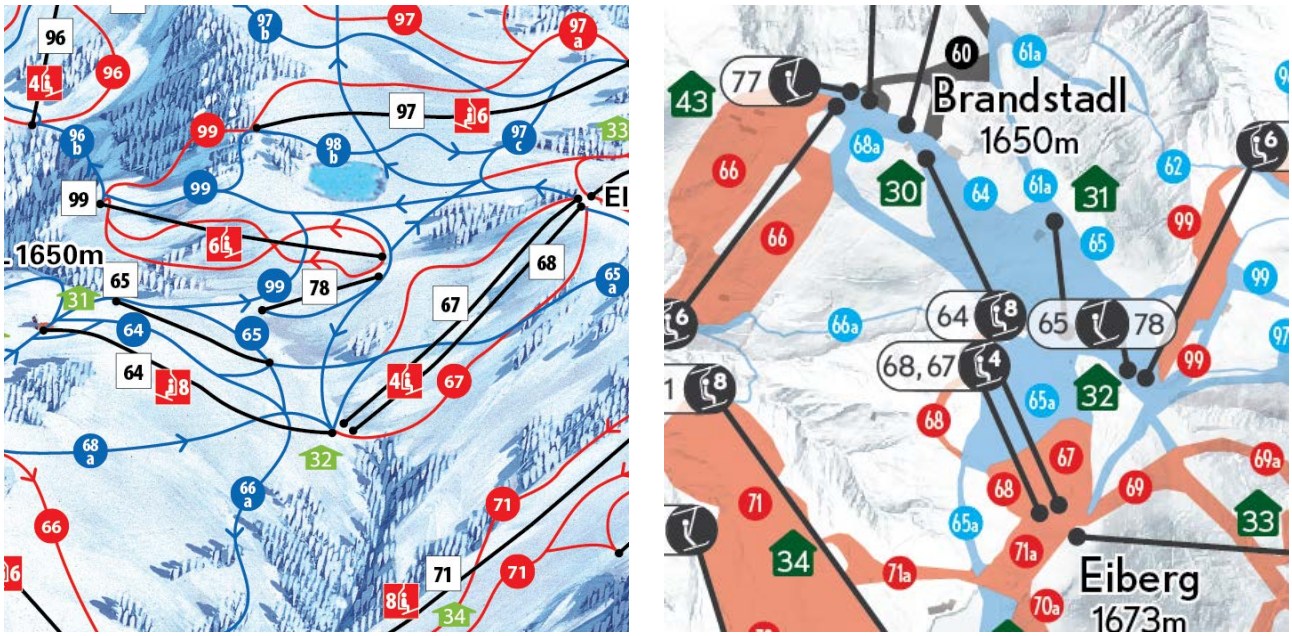

Figure 4.23: Area between Brandstadl and Eiberg as shown on Map A (left) and Map B (right). Sources: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020) (left) and author (right)

On both maps the density of information is high, making at least this part of the map very complex, thus reducing its legibility. Both maps show the beginning of the intended route between Brandstadl and hut 4, with users descending from Brandstadl on slope 64 to lifts 67 and 68, ascending on either of them to Eiberg. The downhill and uphill nature of this part of the route is better visualised on Map A where the differences in terrain height are well discernible. The planimetric view provided by Map B however gives no such impression of the landscape. Although the map shows terrain using hillshading, the area in question is mainly slope area through which, due to the chosen level of opacity, the terrain is barely visible. The author's decision to place lift labels at the entrance of lifts seem to no not have made an impression on the user either. Instead a number of participants using Map B assumed that to get from Eiberg to Fleiding one skies down slope 64 and continuous on to slope 65a to reach the next peak.

The other problematic area of this task relates to the end of the route. The intended route sees users choose slope 2a to descend from Zinsberg to reach hut 4. A number of participants of Group A chose slope 6 instead. Figure 4.24 shows the area in question and how it is shown on Map A and

B. Users of Map A might rightly assume that slope 6 passes hut four just as slope 2a does. The distance between both slope lines to the hut symbol is seemingly the same suggesting access from either side. A look at Map B and these geographically correct visualisation of the area however reveals that the hut is surrounded by the coursing point of slopes 2a and 6a. Slope 6 looks to be considerably further from hut 4 than suggested on Map A. In fact the distance of hut 4 to slope 6 is around 275 meters. As this study has been conducted remotely away from the slopes it is at this point impossible to check the actual accessibility of hut 4 in relation to slope 6. But the distance, the terrain as seen on Map B and on satellite imagery on a map platform such as Google Maps suggest that access would be difficult.

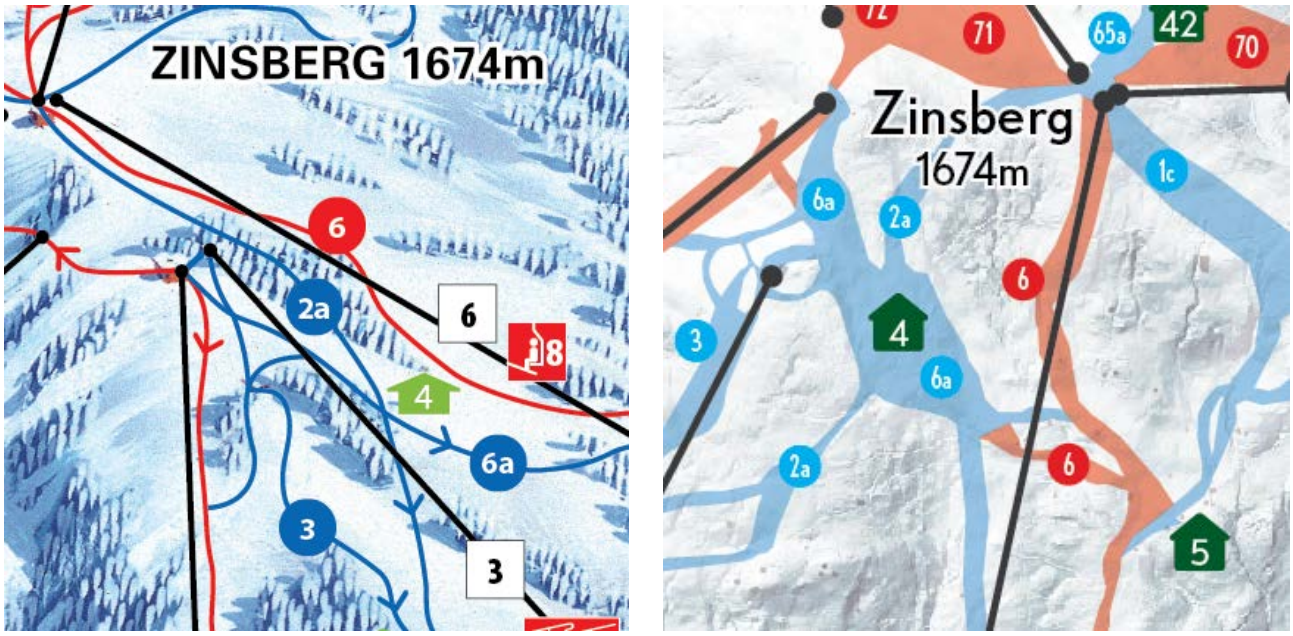

Figure 4.24: Location of hut 4 in relation to slopes 2a and 6 as shown on Map A (left) and Map B (right). Sources: SkiWelt Wilder Kaiser - Brixental Marketing GmbH (2020) (left) and author (right)

4.4 Geographic understanding

Following the navigation and orientation tasks participants of groups A and B were asked to answer three questions related to their geographic understanding of the ski area. Using Map A and B respectively participants had to decide whether the following statements are true or false:

1. Going is located north of Scheffau.
2. Brixen im Thale is located east of Hopfgarten.
3. Hopfgarten is located east of Itter.

Despite both maps being oriented towards different cardinal directions, Map A facing East and Map B facing North, the vast majority of participants of both groups answered all three questions correctly. 97.7% of Group A and 97.1% of Group B correctly stated that Going is not located north of Scheffau (Figure 4.25). More than 90% of participants in Group A (93.2%) and Group B (97.2%) correctly identified Brixen im Thale to be located east of Hopfgarten (Figure 4.26). Similarly, 90.7% and 91.2% of Group A and Group B respectively said that the statement “Hopfgarten is located east of Itter.” is false (Figure 4.27).

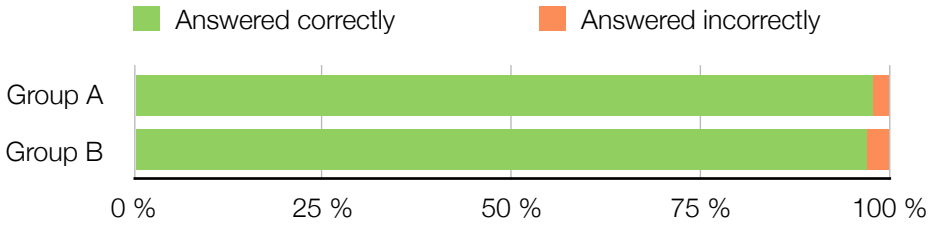

Figure 4.25: Completion of GU task 1

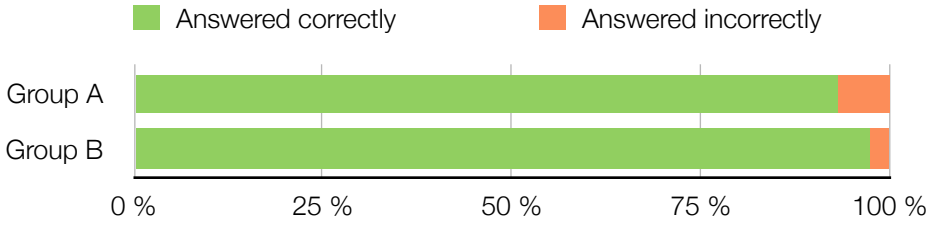

Figure 4.26: Completion of GU task 2

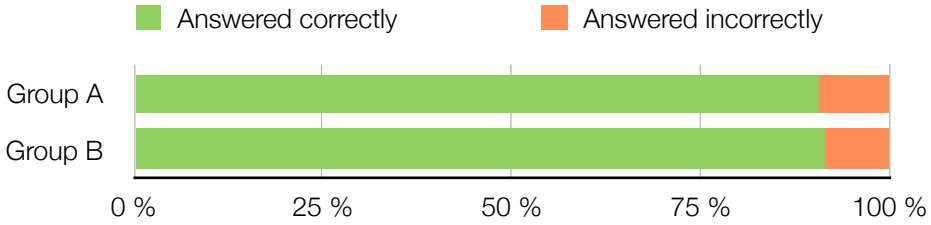

Figure 4.27: Completion of GU task 3

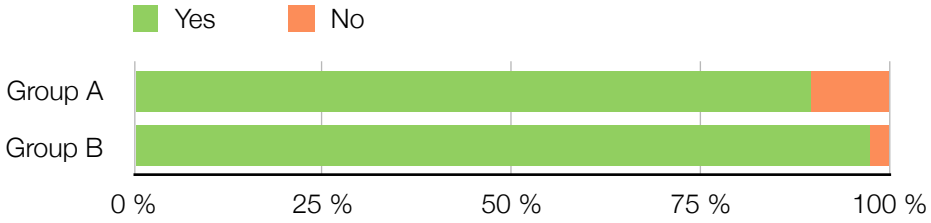

Figure 4.28: Use of map to complete GU tasks

Participants were then asked whether they used their respective maps to help work out the answer to the three aforementioned question, which the majority answered with yes: 89.6% of Group A and 97.3% of Group B (Figure 4.28). 97.7% of Group A and 88.9% of Group B used the north arrow shown on Maps A and B to work out the geographical relationship of the villages whereas only one participant in each group also used the direction indicators pointing to POIs located outside the mapped area as aides, for example, Munich, Salzburg or Innsbruck.

Aside from the use of the compass rose and direction indicators located along the edge of the maps, a few participants mentioned using alternative ways in order to determine the answers including “general topography”, the knowledge that “Scheffau is located near the border with Germany” coupled with the knowledge that “the sun sets behind the Hohe Salve peak when one is located at Brandstadl”, and finally the assumption that “north is at the top of the map”. The latter evidently caused confusion for one participant using Map A who realised that the map was indeed not oriented North and chose to go back within the survey to correct their answers accordingly.

To further assess how Map A and B would affect participants' ability of understanding the geography of the SkiWelt, participants were asked to state their level of agreement to the following information that the maps may provide: slope steepness, slope width, slope length, distances, terrain and the overall geographic understanding of the SkiWelt.

Figures 4.29 and 4.30 show the results for Group A and B respectively. The results suggest that participants of Group B, using Map B, are more in agreement with their map helping them to understand the geography of the SkiWelt with regards to most information types (Figure 4.16). 64.9% and 27% of Group B participants strongly agreed and somewhat agreed respectively that Map B enabled them to understand the width of slopes compared to 29.2% of Group A who only agreed somewhat with regards to Map A. Group B participants also largely agreed that Map B help understand slope length and distances across the map in general, with 51.4% and 43.2% somewhat and strongly agreeing to the former and 48.6% and 37.8% somewhat and strongly agreeing to the latter. The level of agreement with slope steepness and understanding the terrain by using Map B was considerably lower at less than 50% with 21.6% somewhat agreeing and 13.5% strongly agreeing to the former and 18.9% somewhat agreeing and 13.5% strongly agreeing to the latter.

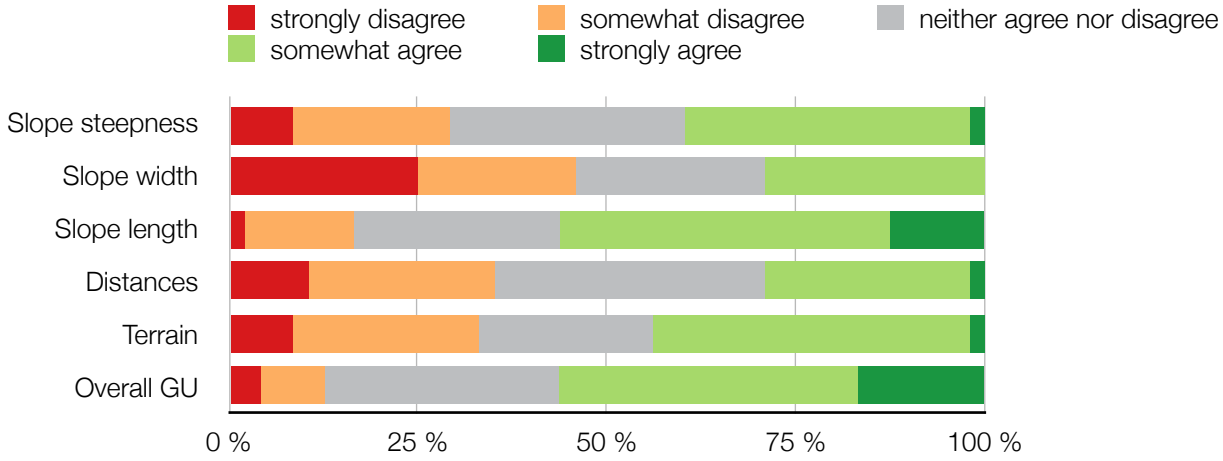

Figure 4.29: Geographical understanding of Group A

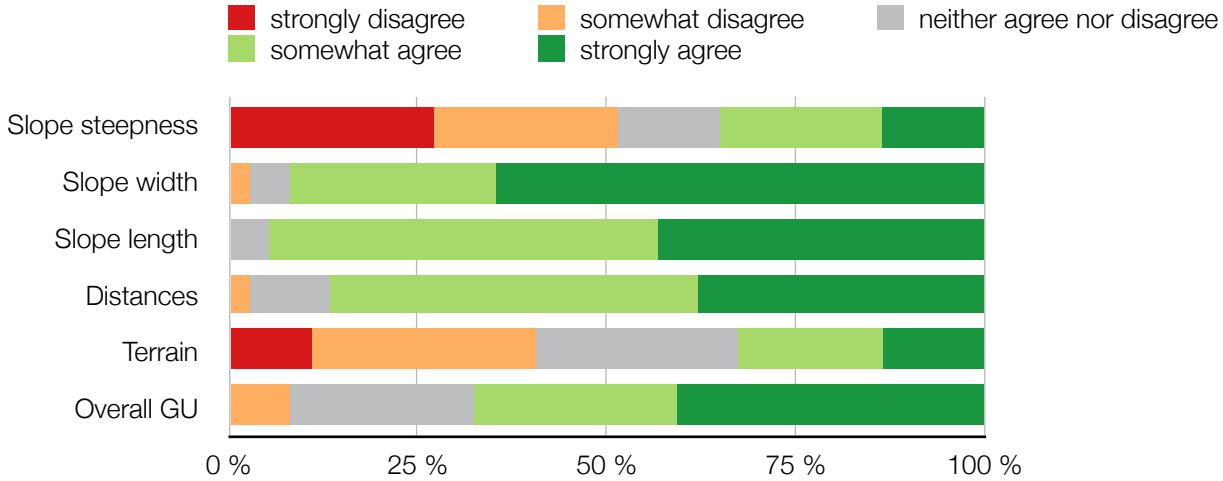

Figure 4.30: Geographical understanding of Group B

The results from participants of Group A who used Map A are notably different to Group B, as their levels of agreement are much lower overall (Figure 15). Whilst the level of overall agreement with slope length is 70%, with 43.8% of participants somewhat and 27.1% strongly agreeing, the level of agreement with slope steepness and width only reaches 39.6% and 29.2% respectively. Participants of Group A mostly agreed that Map B helped to understand slope length and the overall geography of the ski area with 43.8% somewhat agreeing and 12.5% strongly agreeing to the former and 39.6% somewhat agreeing and 16.7% strongly agreeing to the latter. The ability to infer slope width and distances by using Map A was met with the lowest levels of agreement by participants in this group. None strongly agreed, whilst 29.2% somewhat agreed to slope width. Similarly, only 2.1% strongly agreed and 27.1% somewhat agreed that using the map helped gauge distances across the ski area.

Table 4.1: P-values obtained from T-Test for statements related to geographical understanding

The map gives a good impression of how steep the slopes are.	0,22
The map gives a good impression of how wide the slopes are.	0,00
The map gives a good impression of how long the slopes are.	0,00
This map enables to judge distances.	0,00
The map enables to judge the terrain of the SkiWelt and identify particularly steep and flat areas.	0,70
The map provides a good overall geographical understanding of the SkiWelt.	0,05

4.5 Emotional response

The final question posed to participants of the online survey seeks to understand their emotional response to either Map A or Map B. Results suggest that Map A (Figure 4.31) evokes a notably stronger sense of curiosity and slightly stronger level of excitement than Map B (Figure 4.32), but greater degrees of certainty and and confidence are expressed by participants in Group B. Nearly 70% of participants in Group A either somewhat (50%) or strongly agreed (18.8%) that Map A “makes me curious about the SkiWelt and what it has to offer for winter sports”. In comparison, less than 50% of participants viewing Map B agreed with this notion, 27% agreeing somewhat and 21.6% agreeing strongly. Levels of agreement to the statement that the “map gets me excited about the SkiWelt as a winter sport destination I want to spend time at” are also greater for Group A than Group B, though to an overall lesser degree. Asked about their level of agreement with the

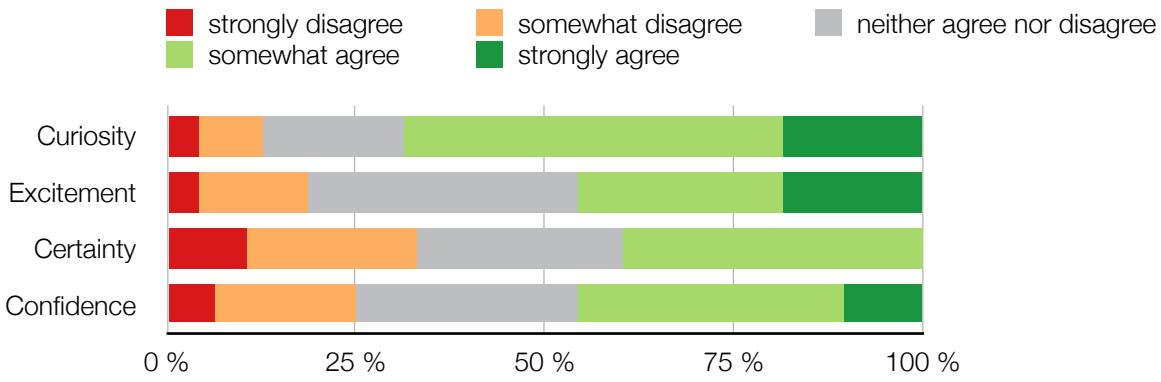

Figure 4.31: Emotional responses of Group A

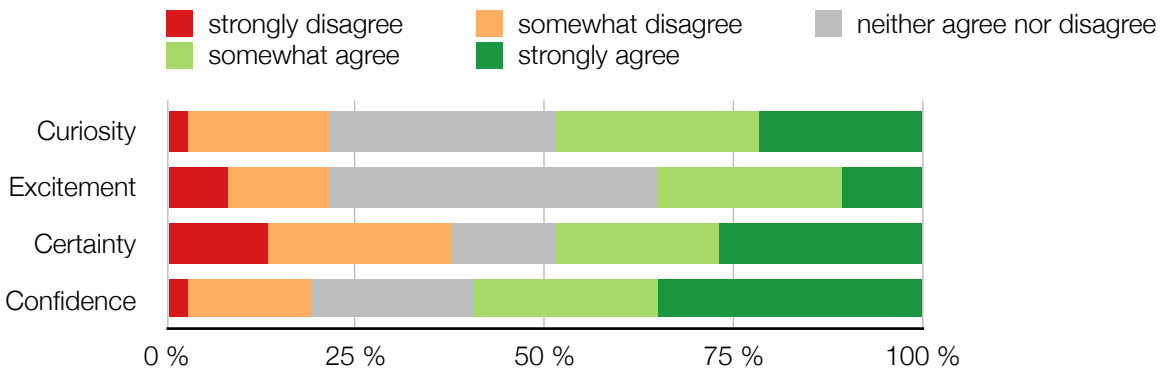

Figure 4.32: Emotional responses of Group B

statement: “This map enables me to judge the terrain and slope characteristics and provides me with a sense of certainty when choosing a slope.”, 39.6% of Group A somewhat agreed, with no strong agreement, as opposed 21.6% of Group B agreeing somewhat and 27% angering strongly. The levels of disagreement, however, are highest for this statement in both groups. Participants of Group A and B, notably disagreed, with 22.9% somewhat disagreeing and 10.4% strongly disagreeing. Viewers of Map B expressed similar sentiments, 24.3% somewhat disagreeing and 13.5% strongly disagreeing with the notion that the map affords a sense of certainty when judging the terrain and slope characteristics. In relation to the last statement, “This ski map gives me confidence that I can navigate and orient myself when I am in the SkiWelt.” notable more participants of Group B assigned a level of strong agreement (35.1%) than participants of Group A (10.4%).

Table 4.2: P-values obtained from T-Test for statements related to emotional responses

Curiosity: This map makes me curious about the SkiWelt and what it has to offer for winter sports.	0,29
Excitement: This map gets me excited about the SkiWelt as a winter sport destination I want to spend time at.	0,28
Certainty: This map enables me to judge the terrain and slope characteristics and provides me with a sense of certainty when choosing a slope.	0,31
Confidence: This ski map gives me confidence that I can navigate and orient myself when I am in the SkiWelt.	0,06

4.6 Discussion

The results from the survey section related to user needs suggest that a legend is the most important element of a ski map. Prior to using either Map A or Map B participants of both groups indicated that an explanation of the comparatively specific symbols and colours used on a ski map are vital. However, after using the maps to complete navigation and orientation tasks, the difficulty highlighted most frequently by participants was not related to the legend but rather the lack of direction indicators for slopes and lifts. In terms of map content, the direction of slopes and lift direction was rated in the survey as third most important by group A and second by group B, with both groups ranking slope difficulty first. The user needs section was deliberately positioned before the introduction of the stimuli in order to avoid answers being influenced by the type of map participants looked at (Figure 3.10). In light of the results the question could be asked as to whether repeating the user needs questions after the introduction of the stimuli at the end of the survey might have shown changes to participants’ assessments of importance in favour of the direction of slopes and lifts.

According to the qualitative results from the navigation and orientation tasks certain types of difficulties are dominant in relation to each stimulus. Across both groups there were 212 comments relating to difficulties experienced, and of these 40 highlighted problems related to the lack of directions of slopes and lifts. 27 of these comments came from participants in group B, suggesting that the depiction of terrain using hillshading was not wholly successful in providing a useful representation of the area's topography and therefore the direction of slopes and lifts. In particular, wider areas of the terrain covered by coloured slope polygons may be difficult to evaluate in terms of their direction. To solve this issue the addition of contour lines should be considered as they are typical for topographic maps to denote changes in terrain. Although the lack of direction was not one of the leading issues for participants in Group A, it received a noteworthy number of mentions (10.1%). The panorama map is more successful in representing the terrain due to its three-dimensional appearance, however the distortion used by the panorama artist to enable areas to be shown that would normally be hidden can lead some parts of the panorama to appear unclear and confusing. This issue has also been recognised in studies conducted by Balzarini et al. (2015) and Balzarini and Murat (2016). To overcome this, some lines representing the slopes include direction arrows however this is not always the case. To address the issue of direction ambiguity on Map A it is worth considering ski maps from Japan. The example from Niseko United (Figures 2.5 and 2.6) shows how all routes, whether slopes or lifts, contain direction information.

The most commonly identified problem with Map A relates to complexity and legibility. 20.2% of qualitative statements from Group A describe difficulties in completing the navigation and orientation tasks due to the map being overly complex or illegible compared to 7.2% from Group B. On Map A this issue is perhaps caused by the often dense network of lines representing lifts and slopes. All lines are of similar width and differ only in terms of their colour. Adding to the complexity are icons representing slope and lift numbers, activity areas and huts. However, this is not to say that any of the information shown on Map A is superfluous. If anything, some participants also mentioned a lack of slope labels which made particularly Task 3 difficult. Contributing to the complex appearance and illegibility may also be the painted panorama forming the basis of the map. Recent changes implemented by a nearby ski area shows how the issue of complexity might be addressed by slightly altering the appearance of the panorama painting. Skicircus Saalbach Hinterglemm Leogang Fieberbrunn used to have a panorama map very similar in style to that of the SkiWelt. The winter sport infrastructure was overlaid onto a painted panorama dominated by varying shades of blue and white (Figure 4.33). A recent initiative to overhaul their slope guiding system[7] also saw a change to the panorama map (Figure 4.32). Aside from changes related to icons and the naming of slopes and lifts, the blue shades of the panorama painting have been turned into greys with only the peaks in the far distance and the sky shown in colour. With a neutral background it may be argued that the line and point features of the map representing the winter sport infrastructure are more visible and legible whilst the network of slopes and lift remains largely unchanged.

The ease with which a destination can be found on a map is a measure of how easy it is to read the map. 14% of qualitative responses by participants using Map A mentioned difficulties with this task, making it the second most commonly raised issue within this group. Reducing visual complexity may also help to resolve issues related to finding specific points on the map. The third main issue related to Map A is the difficulty of making connections between different elements on the map such as connecting from a lift to a slope and vice versa. The generalised visualisation of slopes and lifts may not be ideal to accurately work out connections. As the width of slopes can only be inferred to a degree from the panorama painting it is also difficult to gauge the actual distance between slopes and adjacent POIs, as in the case of Task 3 where hut 4 appeared to be adjacent to slope 6, which in reality it is not.

[7] https://www.saalbach.com/en/winter/ski-resort/piste-guiding-system

Although participants in both Group A and B largely completed the tasks related to geographical understanding correctly, Group B was more in agreement that Map B gave them a better geographical understanding of the ski area. T-tests were performed in order to indicate whether varying the stimulus (Map A or Map B) had an impact on the results. The P-values obtained from the T-tests particularly on the results to do with slope width, slope length and judgement of distances support the hypothesis that changing the variable did have a statistically significant impact (Table 4.1). T-tests were also performed on the evaluations of slope steepness and terrain; here the indication was that changing the variable did not have an impact on the outcome. The P-value obtained from the T-Test for the survey question “The map provides a good overall geographical understanding of the SkiWelt.” however was inconclusive, the P-value obtained being roughly equivalent to the assumed confidence interval of 0.05. The T-tests performed on statements related to emotional response suggest that the stimuli had no impact on the survey outcomes (Table 4.2). It should be noted that some of the assumptions that had to be made when performing the T-tests may not be valid. Although the available sample size is not large enough to enable a confident conclusion of whether the results for each question follow a normal distribution, the available data appears to indicate otherwise in some cases, where answers are polarised at the two extremes of the scale rather than suggesting a single peak tapering off towards the extremes.

Figure 4.33: Panorama map of Skicircus Saalbach Hintergelmm from 2018.
Source: skimap.org (CC BY-NC-SA 3.0 license)

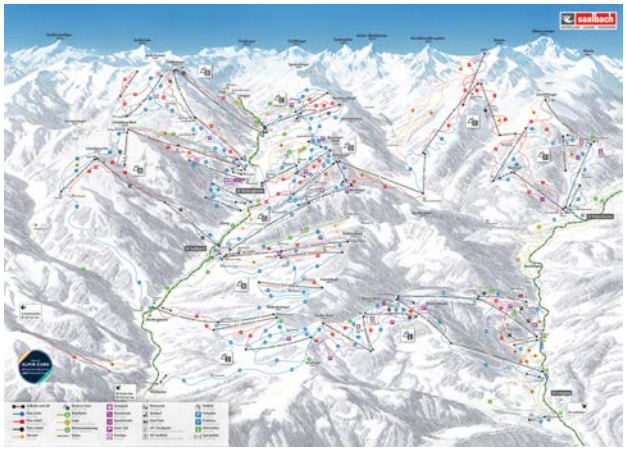

Figure 4.34: Panorama map of Skicircus Saalbach Hintergelmm from 2019.
Source: skimap.org (CC BY-NC-SA 3.0 license)

4.7 Conclusion

The results from the user evaluation do not suggest that one map is more successful overall than the other. Instead, the experiment shows that each presents the users with unique advantages and challenges when used to assist in completing navigation and orientation tasks, highlighting potential areas for improvement as well as features of one map that perform well and which the other could seek to incorporate.

A review of the evaluation method used in light of the survey results points to parts of the online survey that could have been designed differently in hindsight. The results from questions related to the level of difficulty participants had in answering the navigation and orientation questions may have been different if participants had received feedback on whether the routes they chose for the navigation and orientation tasks were correct or not. Group B generally stated that they had found the tasks less difficult than Group A, even though the routes chosen by Group B tended to be incorrect more often, in particular with regard to the second and third most complex navigation tasks. Participants of Group B therefore may have assumed that their answer was correct and thus described the tasks as largely easy. Changing the online survey to surface the correct (or optimum) answer after each task might have enabled participants to make a more informed assessment of the difficulties they had with their respective map.

5. Conclusion and outlook

By evaluating two depictions, panoramic and planimetric, of one ski area this thesis aims to provide a better understanding of the affordances of two different map styles within the context of wayfinding, spatial cognition, emotional response and user needs. It further aims to add to existing research into ski maps and to broaden the scope of research into the cartographic representations of alpine winter sport areas. By evaluating to very different map types and comparing the results, this thesis not only provides insight into how each map performs on its own but allows for a direct comparison of the results from two sample groups. Despite the stark differences which Map A and Map B exhibit, the overall results from the user evaluation are not clear cut, suggesting that neither map is completely successful. Rather, the results suggest that both map types have visual characteristics that are useful for navigation and orientation.

RO3 seeks to make suggestions based on the findings of this study for further research on how panoramic and planimetric maps showing ski areas could be improved and potentially synthesised. Both map types can be improved by addressing the issues raised during the user evaluation. Map B should see improvements relating to the visual representation of the topography so that users can gauge the changes in the terrain and most importantly the direction of slopes and lifts more easily. Improvements for Map A should address its complex appearance and poor legibility. Ambiguous areas of the map where the directions of slopes and lifts are not clear should also be addressed. Viewing either map type in isolation however may not be the best way to approach RO3. The current dual use of the panorama map and the potential issues related to it should be a focus on future research into the usability and improvement of ski maps. Apart from the idea of synthesising both map types and their visual characteristics, a focus could be to consider other types of maps and map-related visualisations that may be suitable for depicting a ski area for the purpose of navigation and orientation. Aside from revisiting the idea of the schematic ski map (Field 2010) and develop it further, the ultimate aim could be to develop a *suite of maps* for a ski area. Ski areas tend to be complex and so are their user journeys and experiences. The one-size-fits-all approach does not seem to work when a user experience is as complex as in the case of alpine winter tourism. The user experience, if considered as a whole, starts at home where the potential visitor is likely to engage with the ski area through its website. Here the the map is a marketing tool, made to entice and attract in the first place, less so to support wayfinding. Once at the destination the user will have different information requirements including navigation and orientation. The panorama map may still be relevant as this point but should be supplemented with cartographic tools that are more tailored to supporting navigation and orientation.

Aside from future research objectives addressing the design and scope of mapping ski areas, the research methods should be optimised accordingly. The user evaluation method chosen for this thesis was affected by external circumstances (COVID-19) that meant a remote online survey was most practical. The aim of future research, however, should be to employ evaluation methods such as participant observation, thinking aloud and interviews. Moreover, conducting the research in situ should be a priority if possible. Looking ahead, potential further research may also benefit from better targeting. A more complete understanding of the potential user groups, their journeys and specific user needs would not only provide a more comprehensive knowledge base on which to base potential cartographic elements contained in a suite of ski maps but would also better inform the composition of sample groups and avoid random sampling.

The questionnaire completed by a representative of SkiWelt Wilder Kaiser - Brixental Marketing GmbH as part of this thesis (Janssen, 2020) provided some insight into how and for whom the current ski panorama is created. Again, it maybe beneficial to the outcomes of future research if destination marketing organisations such as this could be more closely involved in the research and evaluation process as they are they are in many cases the publishers and distributors of ski maps.

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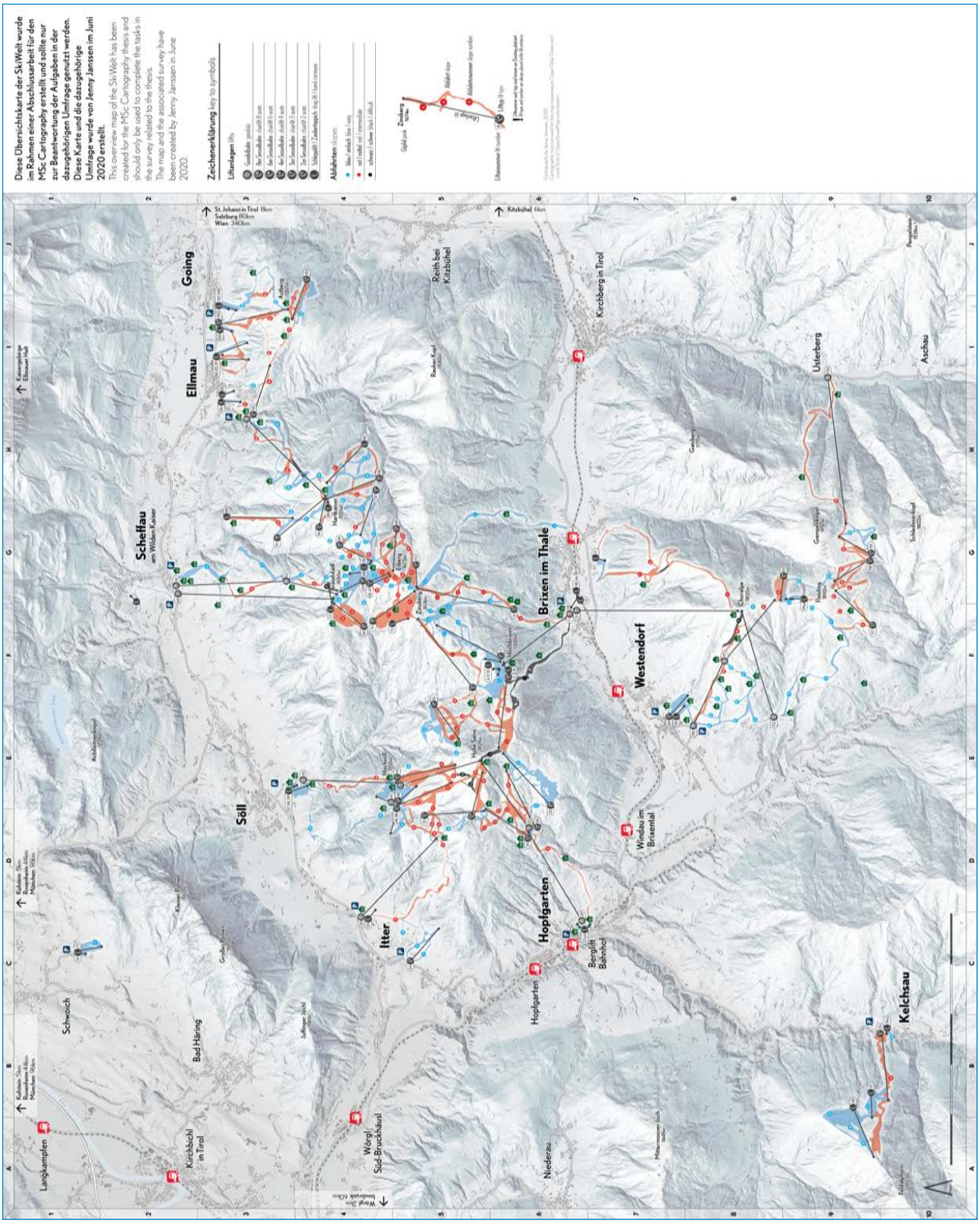
Appendices

Appendix 1

Map A (Source: SkiWelt Wilder Kaiser - Brixental Marketing GmbH, 2020)

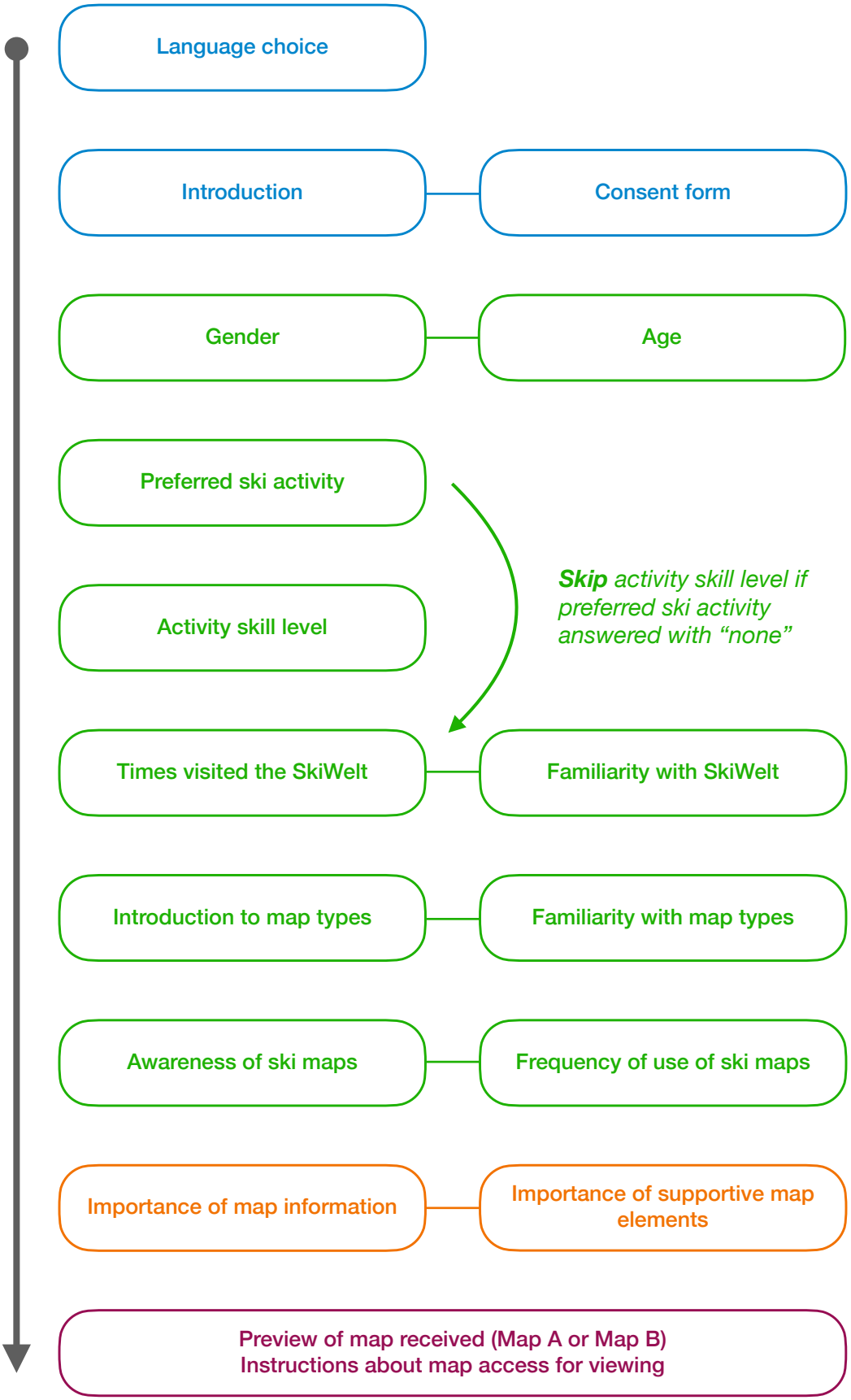
Appendix 2

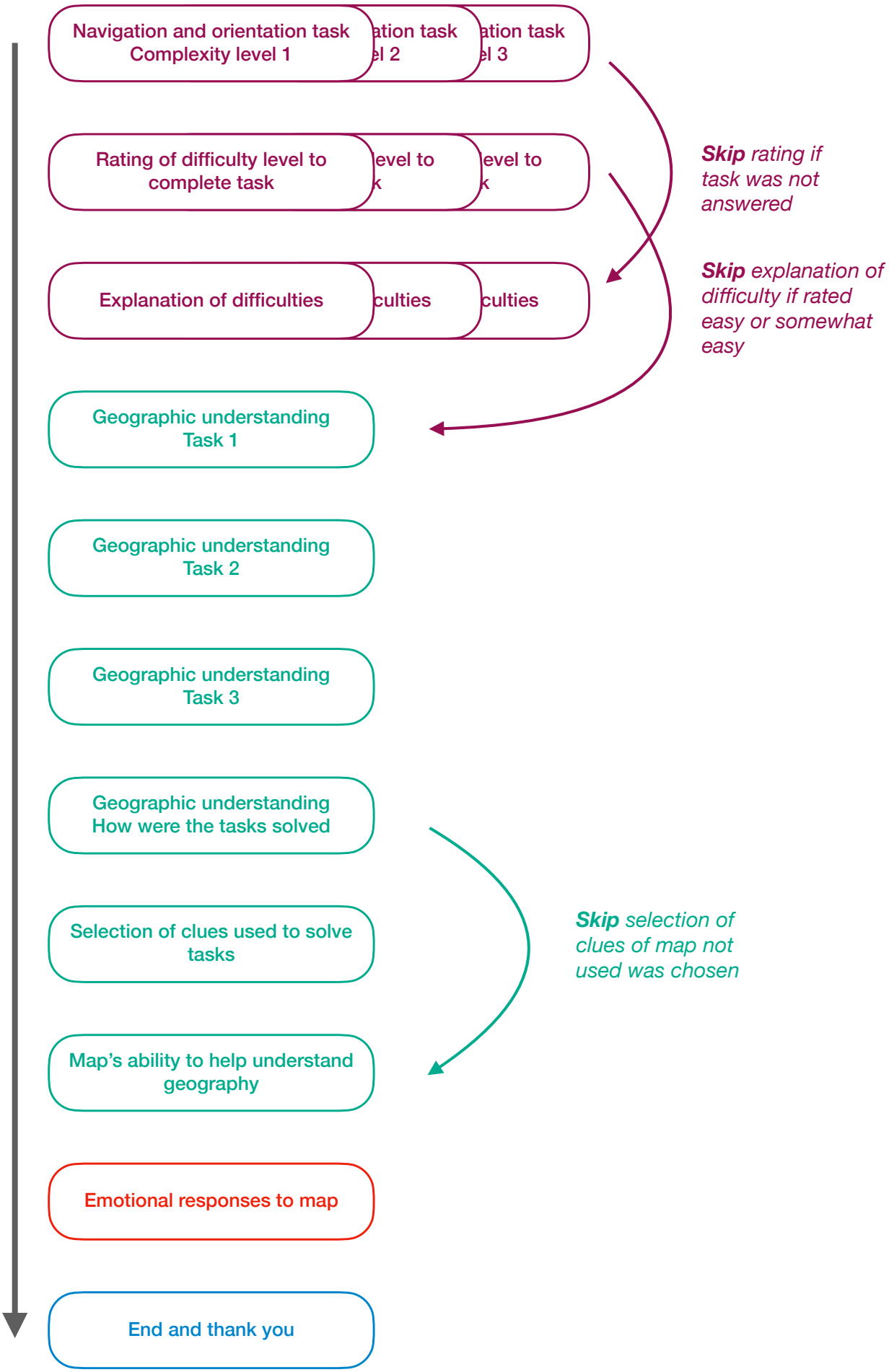
Map B (Source: Janssen, 2020)



Appendix 3

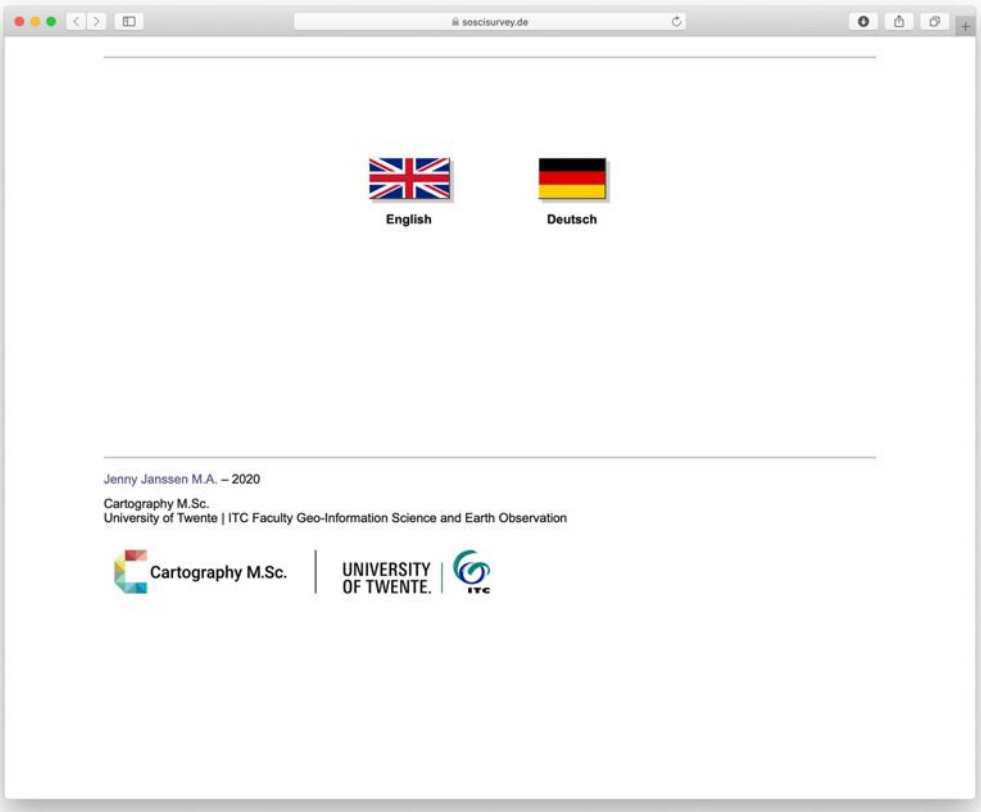
Online survey structure

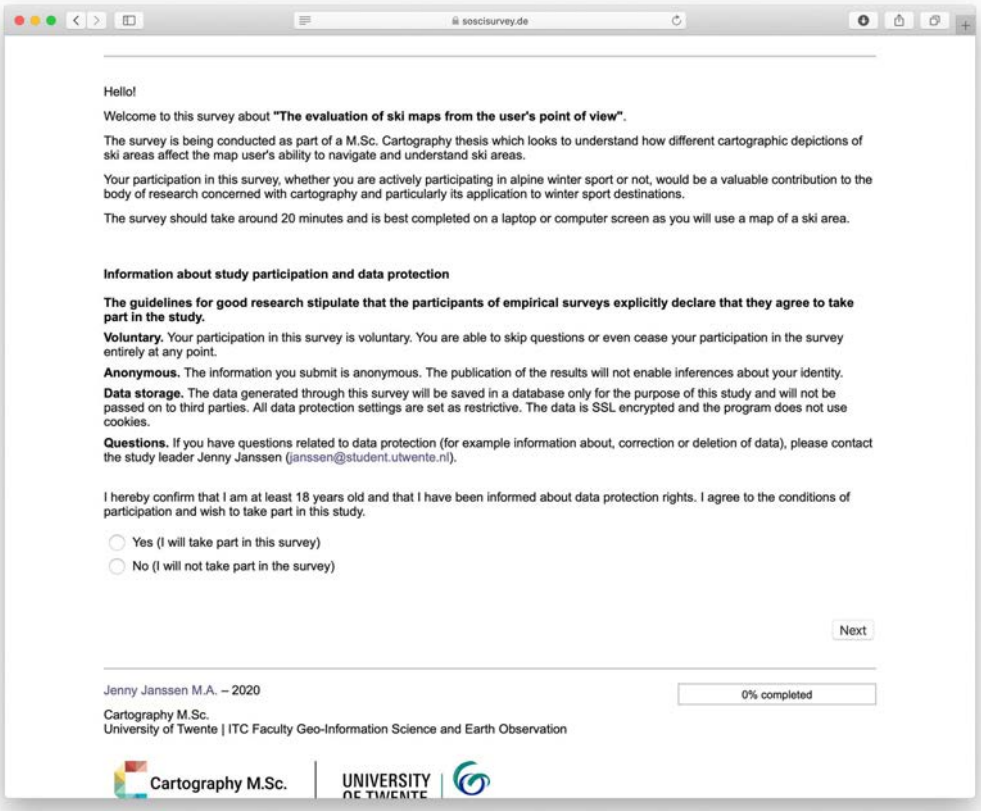


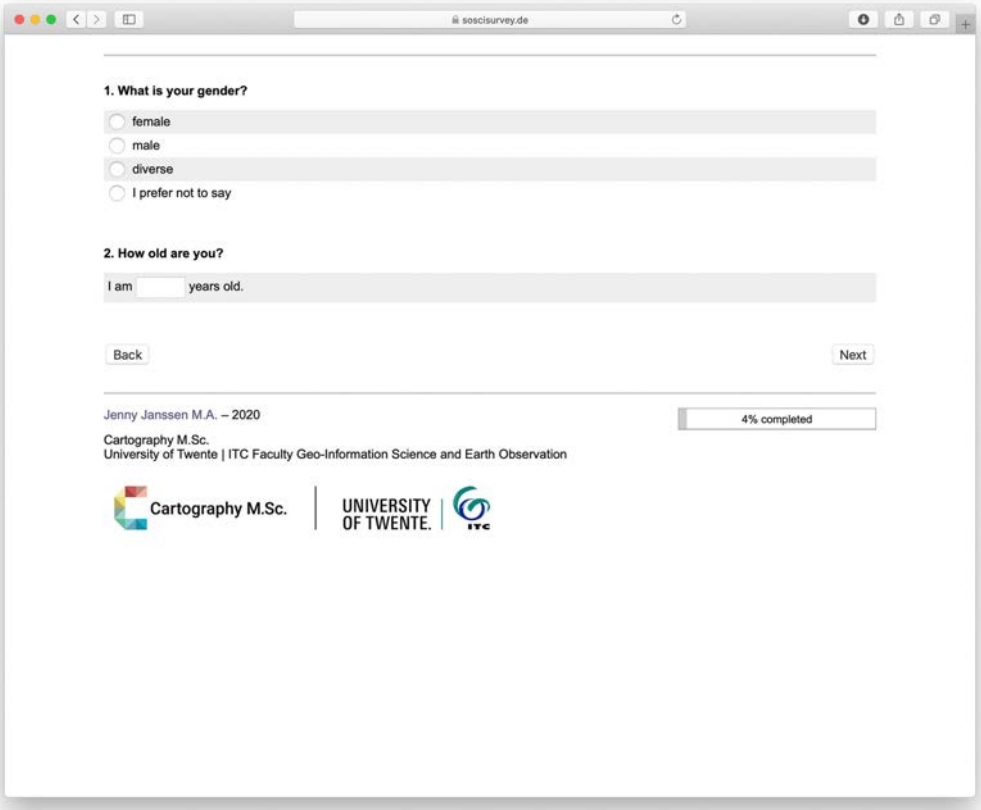

Navigation and orientation task Complexity level 1
Rating of difficulty level to complete task
Explanation of difficulties
Skip rating if task was not answered
Skip explanation of difficulty if rated easy or somewhat easy
Geographic understanding Task 1
Geographic understanding Task 2
Geographic understanding Task 3
Geographic understanding How were the tasks solved
Selection of clues used to solve tasks
Skip selection of clues of map not used was chosen
Map's ability to help understand geography
Emotional responses to map
End and thank you

Appendix 4

Screenshots of of each page of the online survey






soscisurvey.de
1. What is your gender?
female
male
diverse
I prefer not to say
2. How old are you?
I am
years old.
Back
Next
Jenny Janssen M.A. – 2020
4% completed
Cartography M.Sc.
University of Twente | ITC Faculty Geo-Information Science and Earth Observation
Cartography M.Sc.
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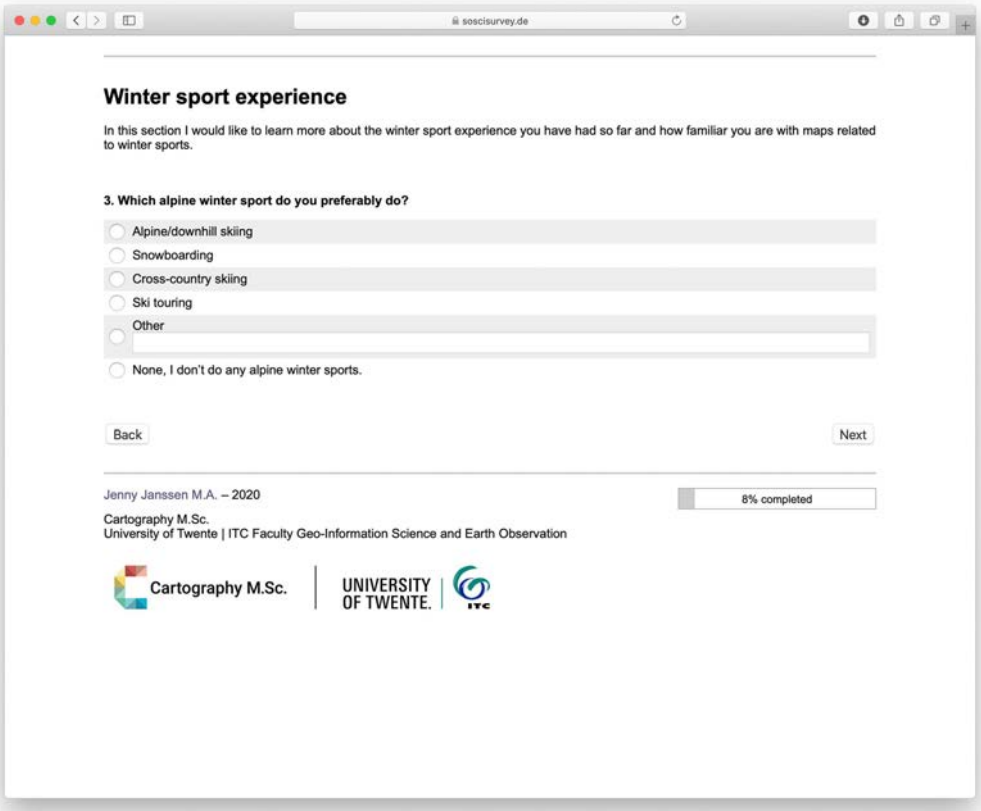
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Winter sport experience
In this section I would like to learn more about the winter sport experience you have had so far and how familiar you are with maps related to winter sports.
3. Which alpine winter sport do you preferably do?
Alpine/downhill skiing
Snowboarding
Cross-country skiing
Ski touring
Other
None, I don't do any alpine winter sports.
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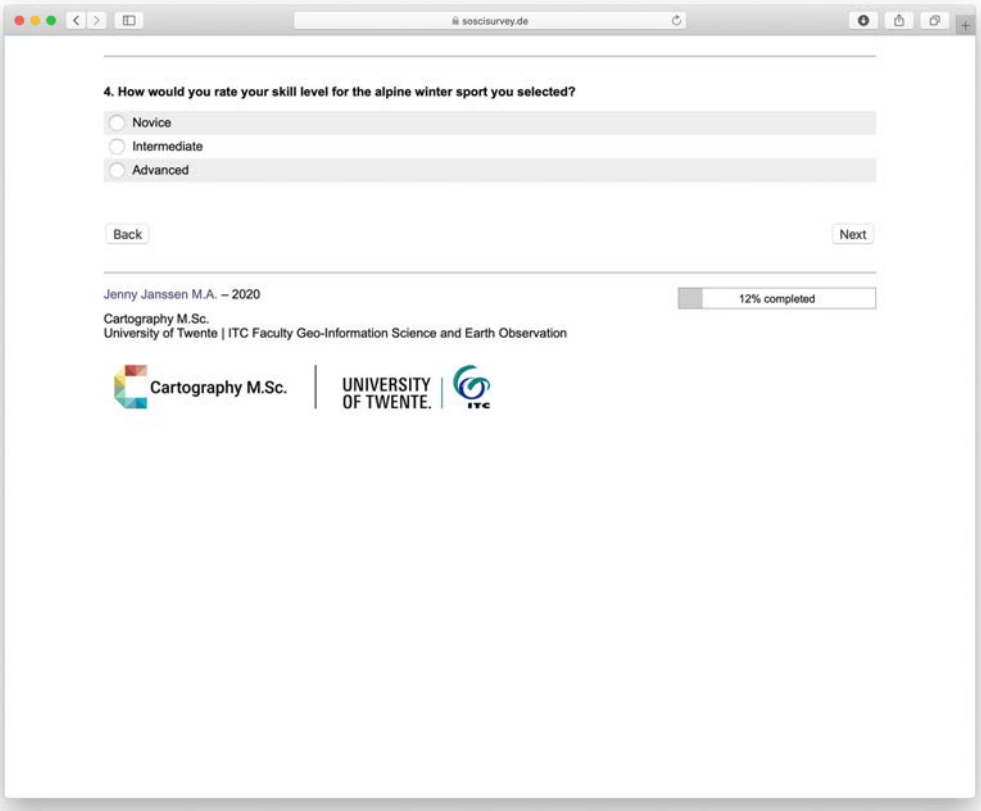
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4. How would you rate your skill level for the alpine winter sport you selected?
Novice
Intermediate
Advanced
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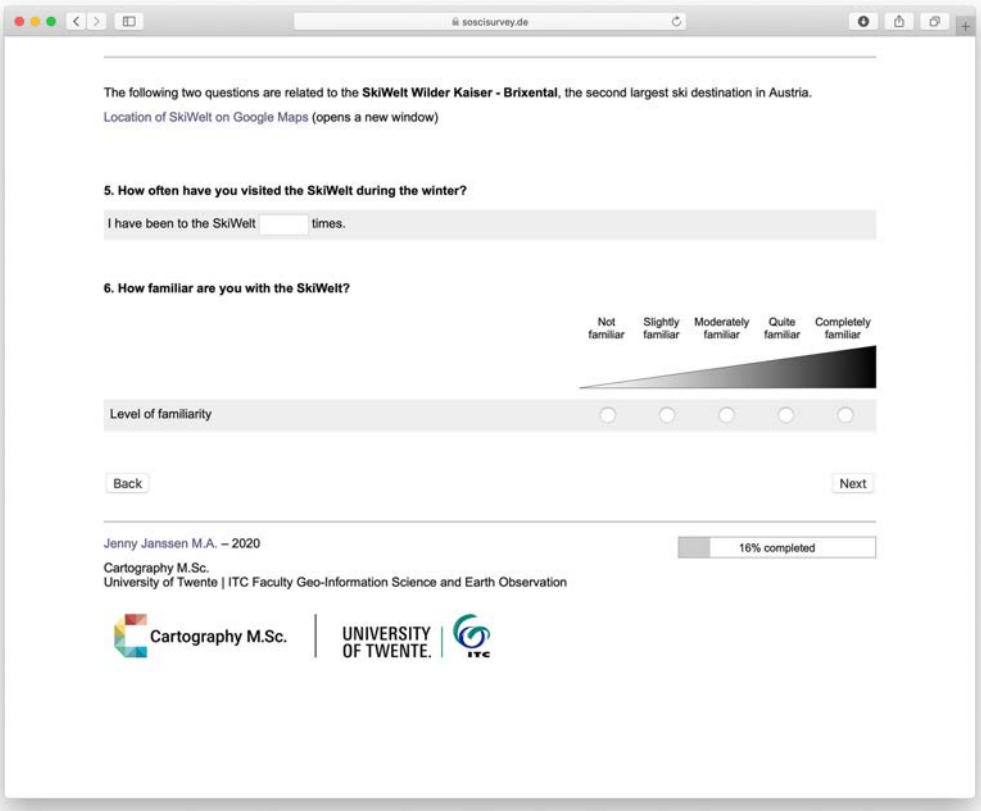
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The following two questions are related to the SkiWelt Wilder Kaiser - Brixental, the second largest ski destination in Austria.
Location of SkiWelt on Google Maps (opens a new window)
5. How often have you visited the SkiWelt during the winter?
I have been to the SkiWelt times.
6. How familiar are you with the SkiWelt?
Not familiar
Slightly familiar
Moderately familiar
Quite familiar
Completely familiar
Level of familiarity
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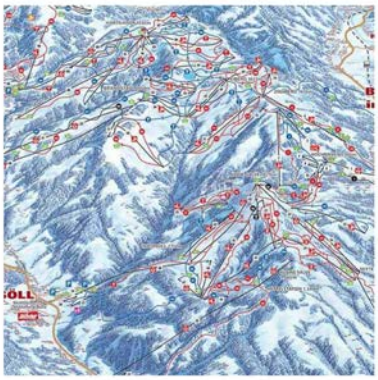
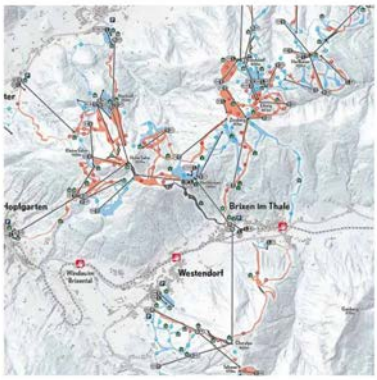
Familiarity with different map types.

Below are two different types of maps depicting sections of the SkiWelt:

On the **left** is part of a **panorama map**, commonly used to depict mountainous winter and summer destinations. The viewer has a bird's eye view over the landscape. The panorama is not to scale.

On the **right** is part of a **terrain map** showing the same ski destination as the ski panorama. The terrain map provides a plan-view of the area and is to scale.





7. How familiar are you with these types of maps?

	Not at all familiar	Slighty familiar	Moderately familiar	Quite familiar	Completely familiar
Ski panorama	○	○	○	○	○
Shaded relief terrain map	○	○	○	○	○

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8. Which of the following types of ski maps have you encountered?

	Yes	No
Printed ski map (usually folded)	○	○
Large static ski map display board (usually located at at lifts)	○	○
Digital and interactive ski map with real-time information such as lift and piste closures (usually viewed online in a web browser or app)	○	○
PDF ski map for download	○	○

9. How often do you use these different map types when out on the slopes?

	Never	Almost never	Sometimes	Almost every time	Every time
Printed ski map (usually folded)	○	○	○	○	○
Large static ski map display board (usually located at at lifts)	○	○	○	○	○
Digital and interactive ski map with real-time information such as lift and piste closures (usually viewed online in a web browser or app)	○	○	○	○	○
PDF ski map for download	○	○	○	○	○

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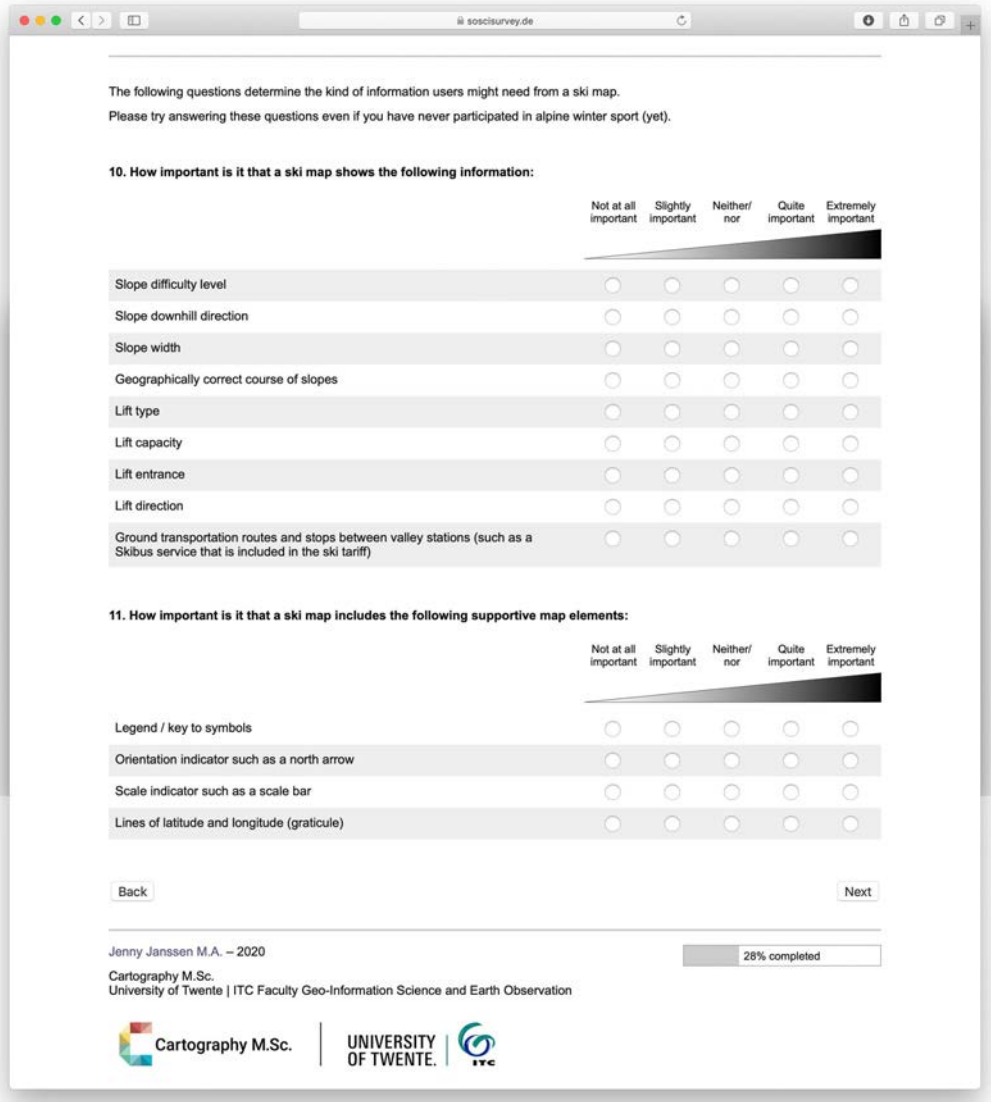
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The following questions determine the kind of information users might need from a ski map.
Please try answering these questions even if you have never participated in alpine winter sport (yet).
10. How important is it that a ski map shows the following information:
Not at all important
Slightly important
Neither/ nor
Quite important
Extremely important
Slope difficulty level
Slope downhill direction
Slope width
Geographically correct course of slopes
Lift type
Lift capacity
Lift entrance
Lift direction
Ground transportation routes and stops between valley stations (such as a Skibus service that is included in the ski tariff)
11. How important is it that a ski map includes the following supportive map elements:
Not at all important
Slightly important
Neither/ nor
Quite important
Extremely important
Legend / key to symbols
Orientation indicator such as a north arrow
Scale indicator such as a scale bar
Lines of latitude and longitude (graticule)
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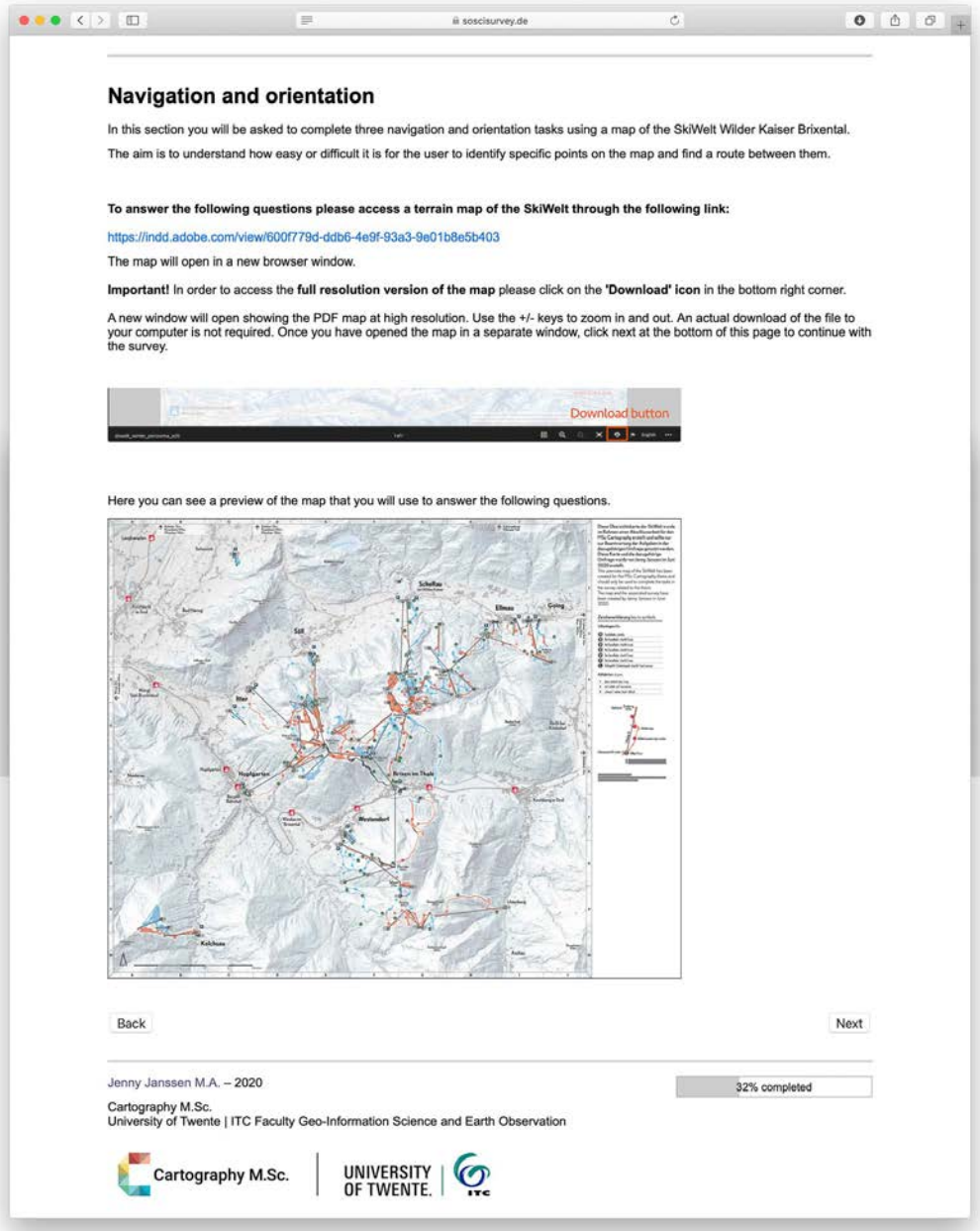
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Navigation and orientation
In this section you will be asked to complete three navigation and orientation tasks using a map of the SkiWelt Wilder Kaiser Brixental.
The aim is to understand how easy or difficult it is for the user to identify specific points on the map and find a route between them.
To answer the following questions please access a terrain map of the SkiWelt through the following link:
https://indd.adobe.com/view/600f779d-ddb6-4e9f-93a3-9e01b8e5b403
The map will open in a new browser window.
Important! In order to access the full resolution version of the map please click on the 'Download' icon in the bottom right corner.
A new window will open showing the PDF map at high resolution. Use the +/- keys to zoom in and out. An actual download of the file to your computer is not required. Once you have opened the map in a separate window, click next at the bottom of this page to continue with the survey.
Download button
Here you can see a preview of the map that you will use to answer the following questions.
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12. Using lifts and/or slopes, how would you get from Söll to Hohe Salve?
Please list each lift/slope you would take to complete the route by naming the lifts and/or slopes in the order you would take them.
Separate each step by a comma.
I would take the following lifts/slopes:
For example: Lift 1, Slope 1, Lift 2, Slope 2a...
I was not able to answer this question.
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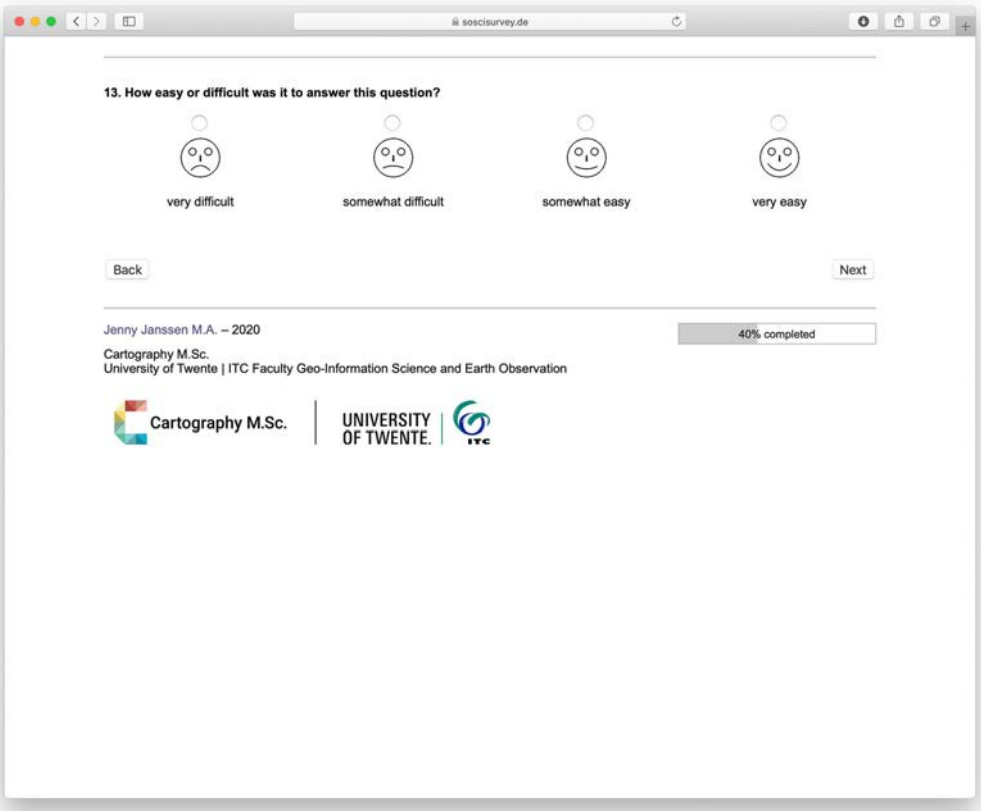
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13. How easy or difficult was it to answer this question?
very difficult
somewhat difficult
somewhat easy
very easy
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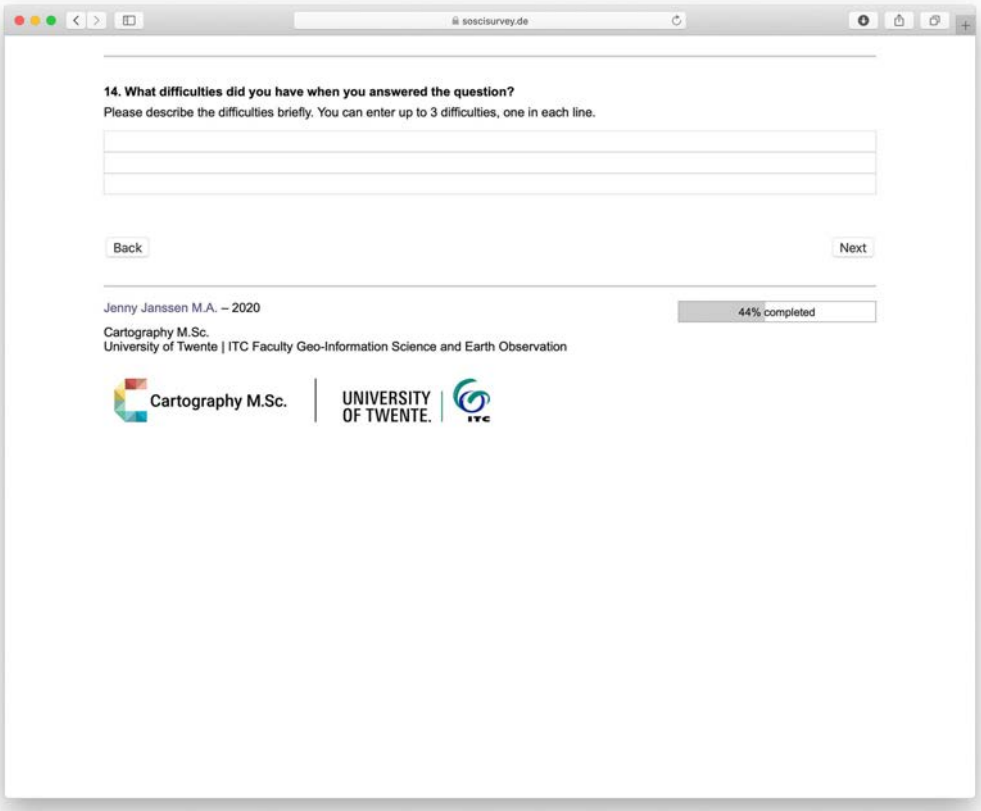
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14. What difficulties did you have when you answered the question?
Please describe the difficulties briefly. You can enter up to 3 difficulties, one in each line.
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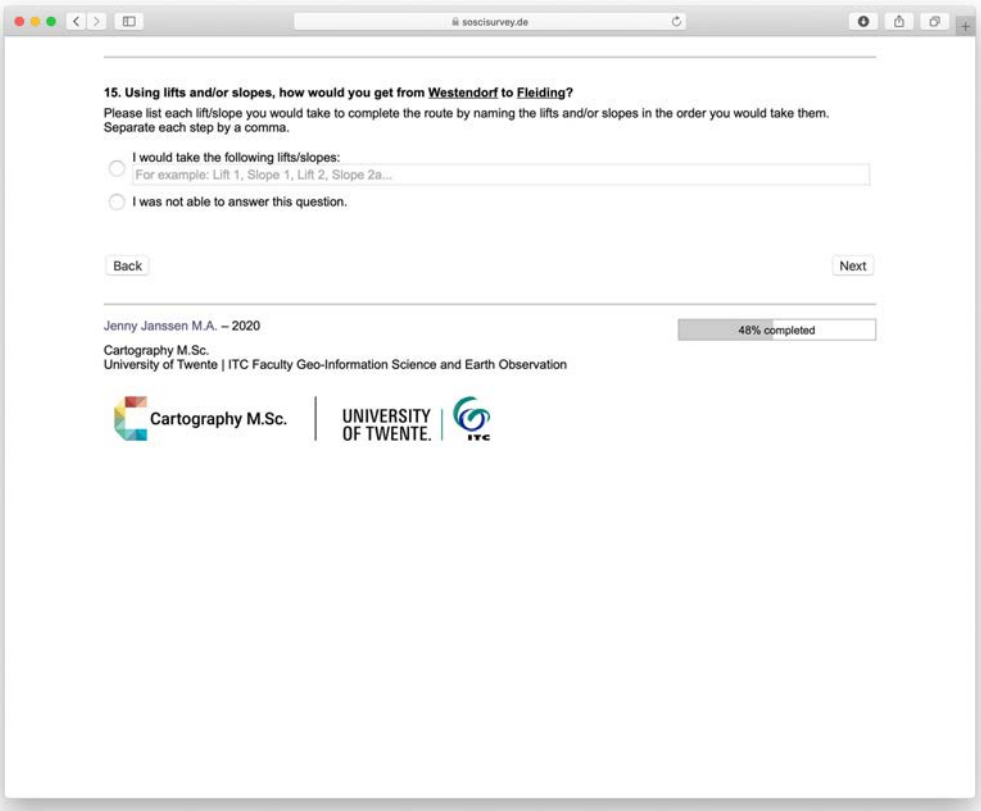
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15. Using lifts and/or slopes, how would you get from Westendorf to Fleiding?
Please list each lift/slope you would take to complete the route by naming the lifts and/or slopes in the order you would take them.
Separate each step by a comma.
I would take the following lifts/slopes:
For example: Lift 1, Slope 1, Lift 2, Slope 2a...
I was not able to answer this question.
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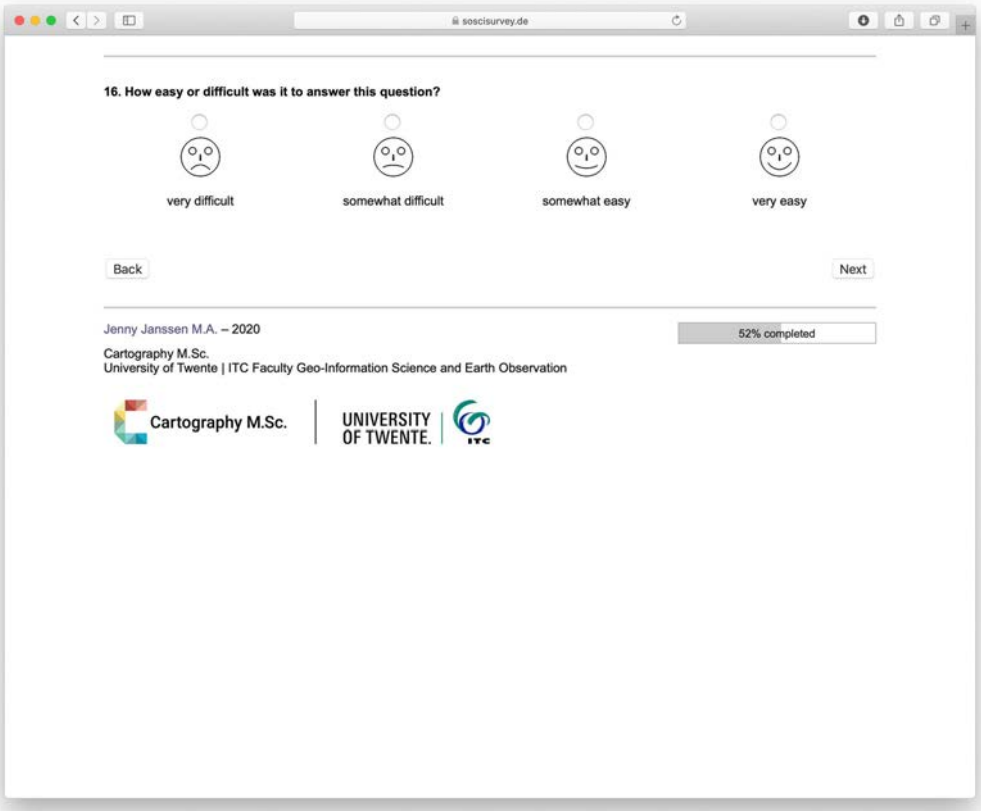
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16. How easy or difficult was it to answer this question?
very difficult
somewhat difficult
somewhat easy
very easy
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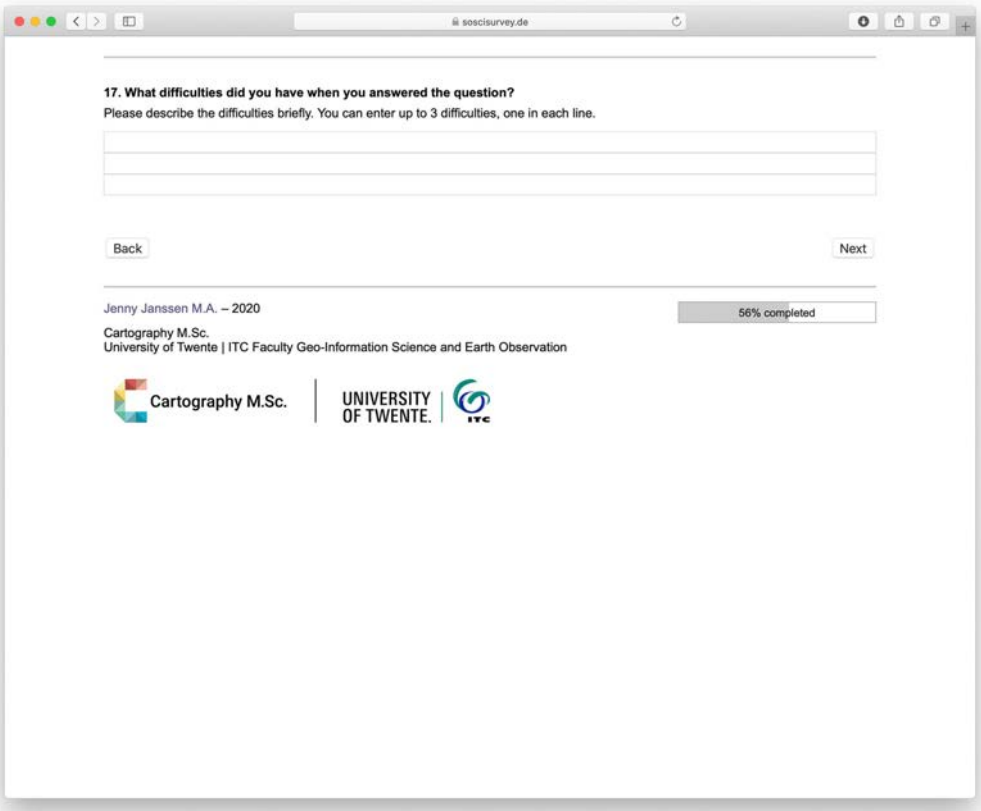
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17. What difficulties did you have when you answered the question?
Please describe the difficulties briefly. You can enter up to 3 difficulties, one in each line.
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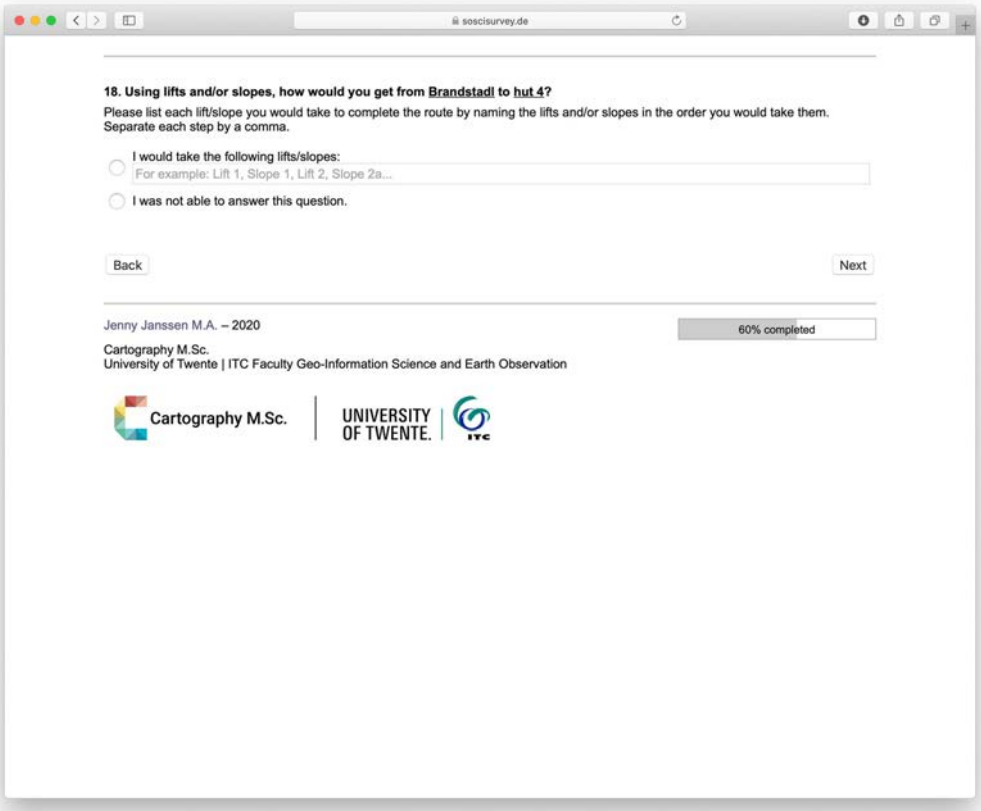
soscisurvey.de
18. Using lifts and/or slopes, how would you get from Brandstadl to hut 4?
Please list each lift/slope you would take to complete the route by naming the lifts and/or slopes in the order you would take them.
Separate each step by a comma.
I would take the following lifts/slopes:
For example: Lift 1, Slope 1, Lift 2, Slope 2a...
I was not able to answer this question.
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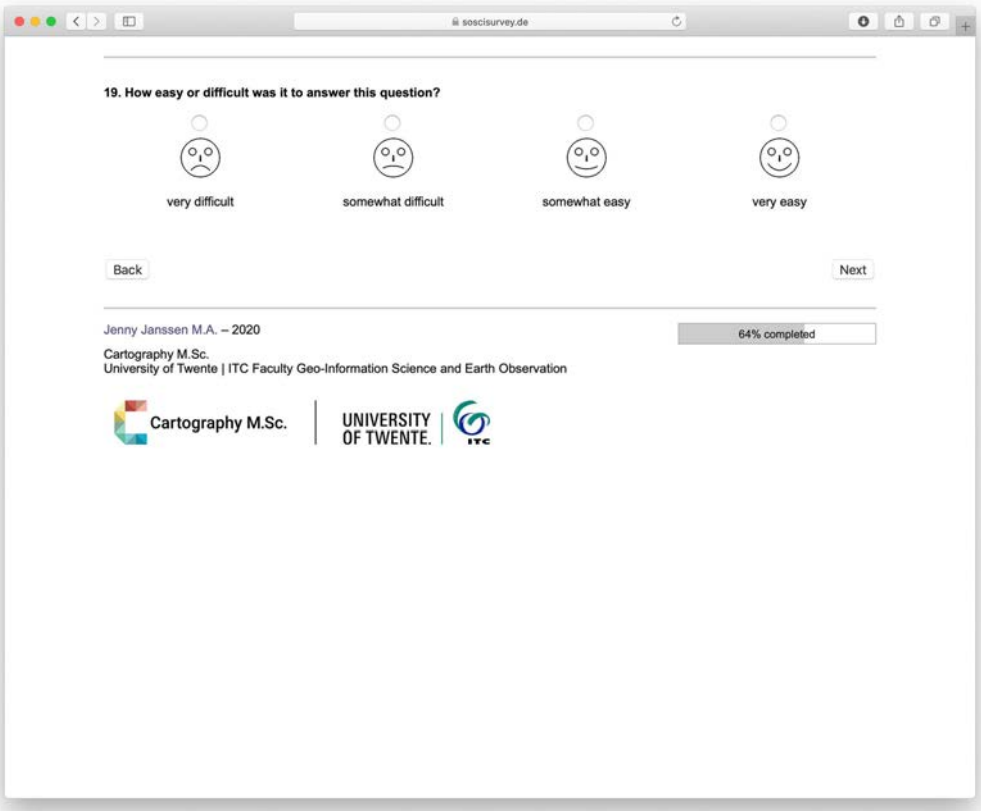
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19. How easy or difficult was it to answer this question?
very difficult
somewhat difficult
somewhat easy
very easy
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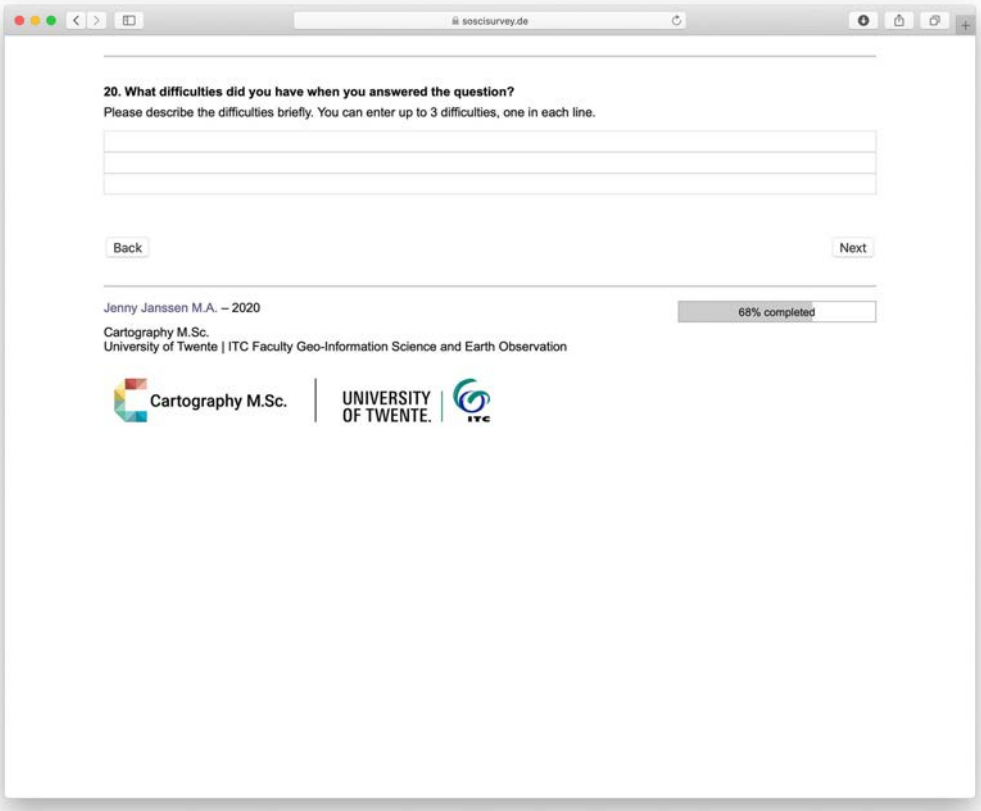
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20. What difficulties did you have when you answered the question?
Please describe the difficulties briefly. You can enter up to 3 difficulties, one in each line.
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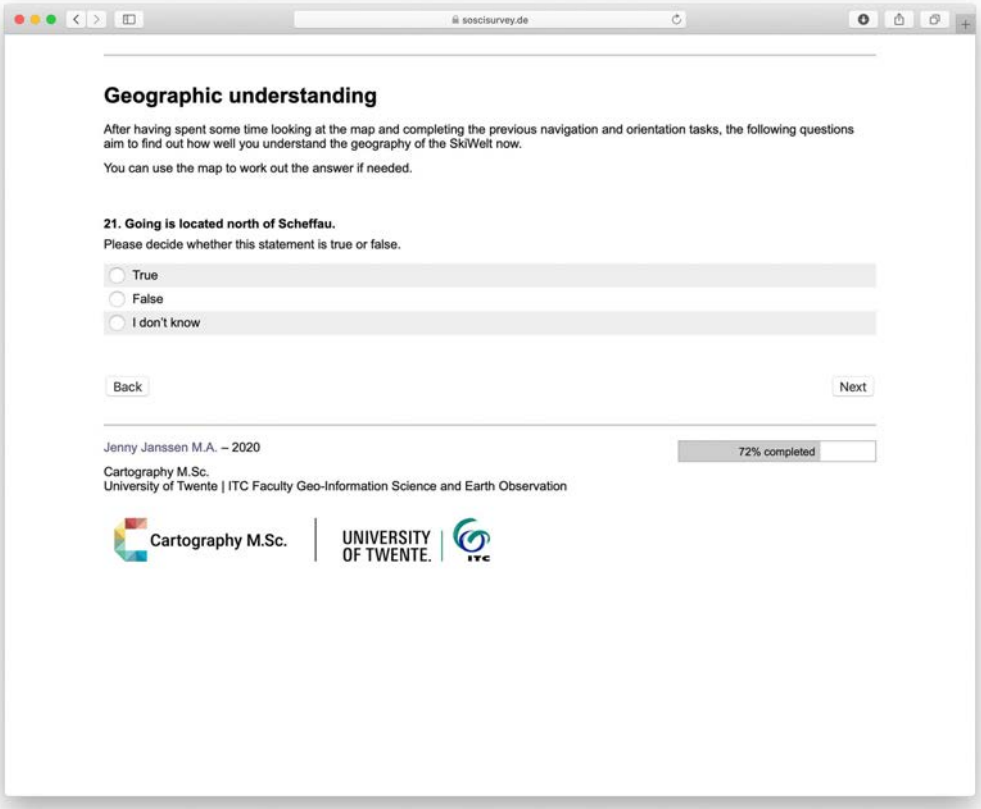
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Geographic understanding
After having spent some time looking at the map and completing the previous navigation and orientation tasks, the following questions aim to find out how well you understand the geography of the SkiWelt now.
You can use the map to work out the answer if needed.
21. Going is located north of Scheffau.
Please decide whether this statement is true or false.
True
False
I don't know
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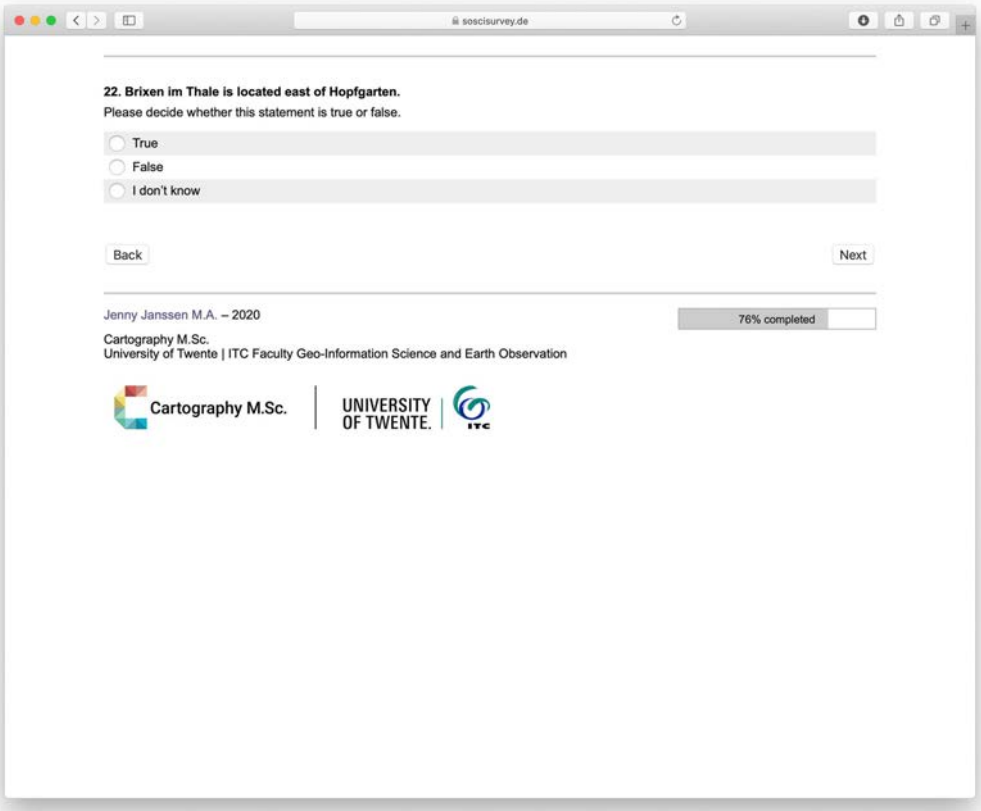
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22. Brixen im Thale is located east of Hopfgarten.
Please decide whether this statement is true or false.
True
False
I don't know
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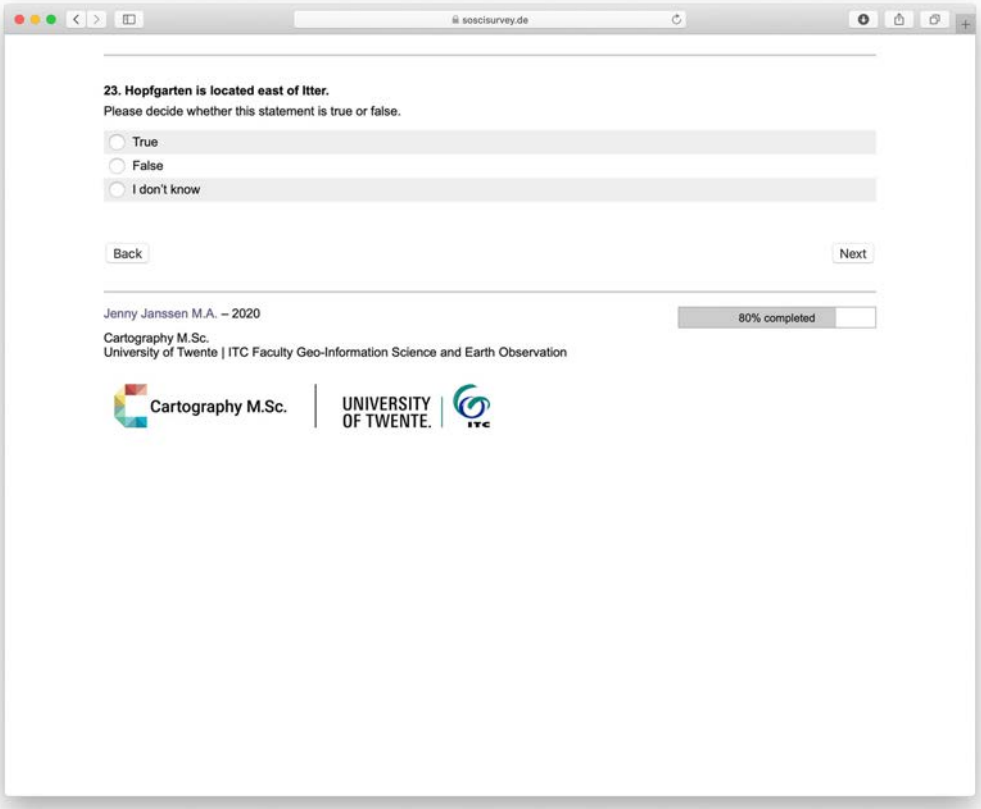
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23. Hopfgarten is located east of Itter.
Please decide whether this statement is true or false.
True
False
I don't know
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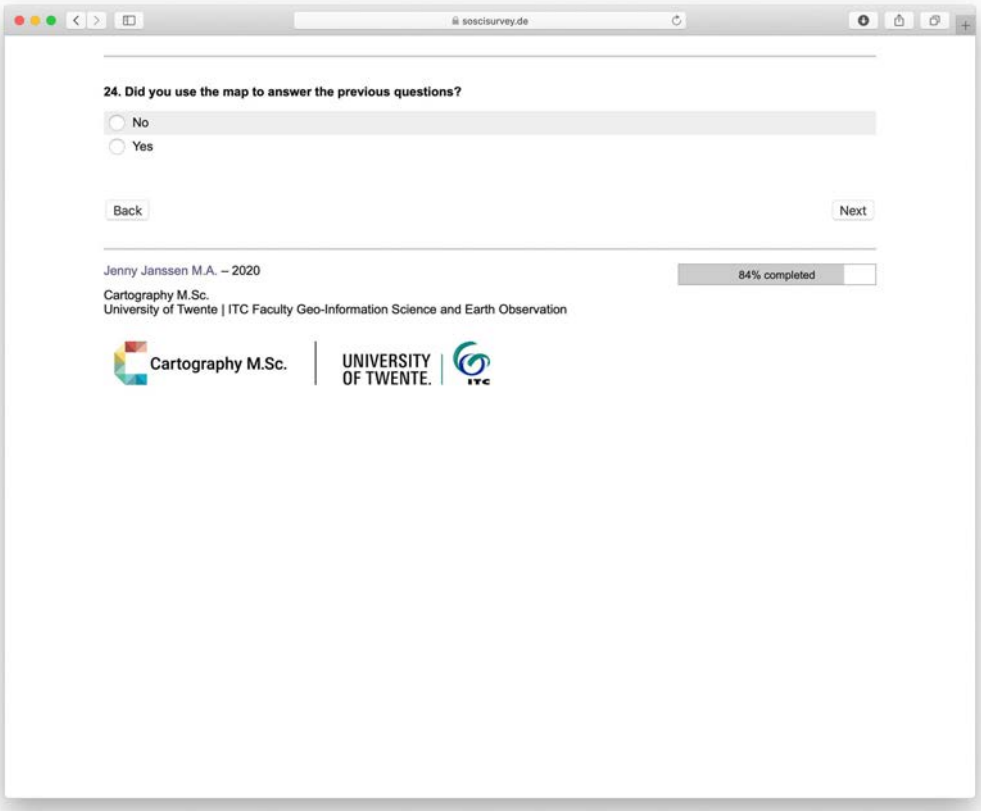
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24. Did you use the map to answer the previous questions?
No
Yes
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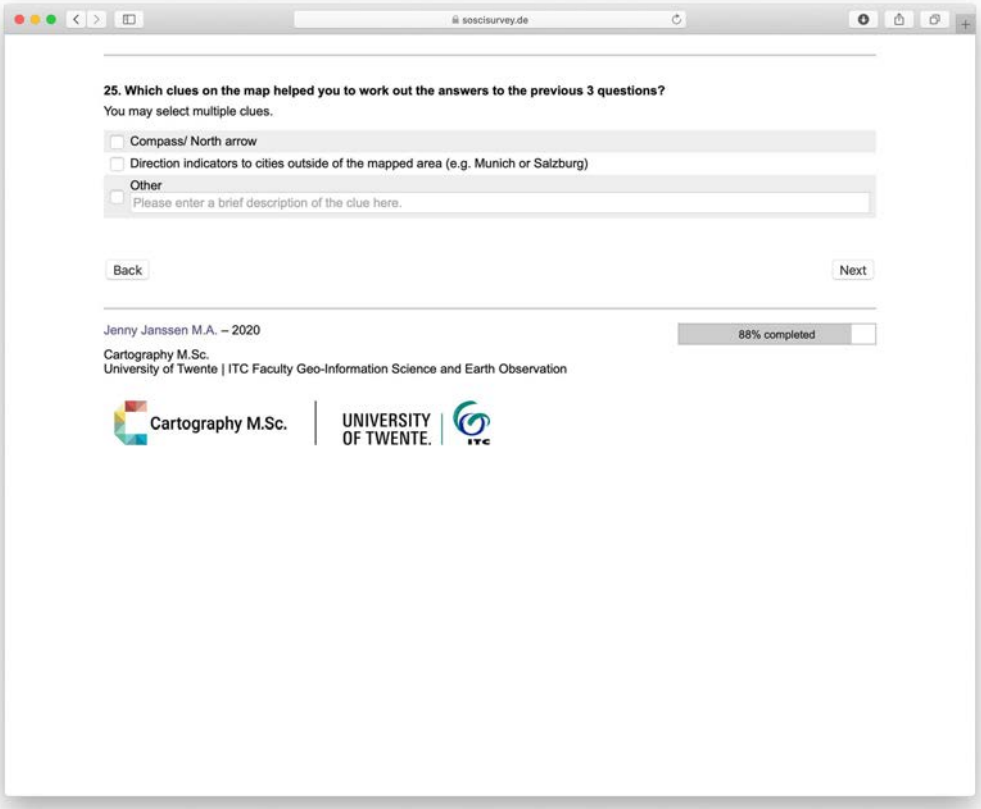
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25. Which clues on the map helped you to work out the answers to the previous 3 questions?
You may select multiple clues.
Compass/ North arrow
Direction indicators to cities outside of the mapped area (e.g. Munich or Salzburg)
Other
Please enter a brief description of the clue here.
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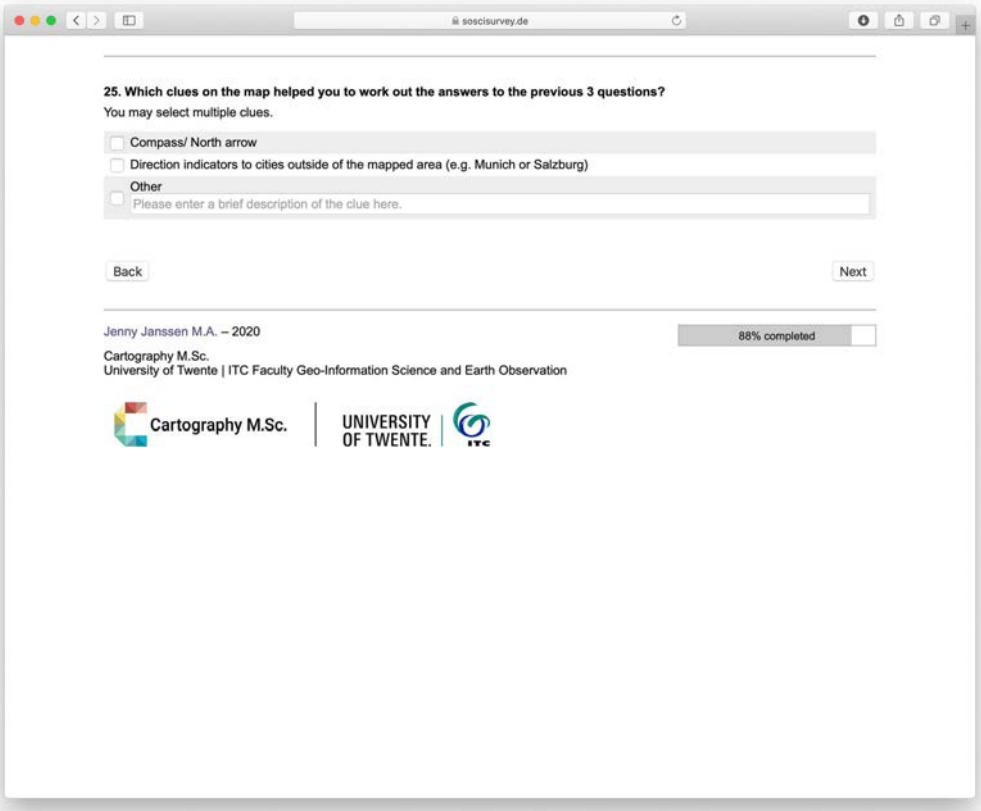
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25. Which clues on the map helped you to work out the answers to the previous 3 questions?
You may select multiple clues.
Compass/ North arrow
Direction indicators to cities outside of the mapped area (e.g. Munich or Salzburg)
Other
Please enter a brief description of the clue here.
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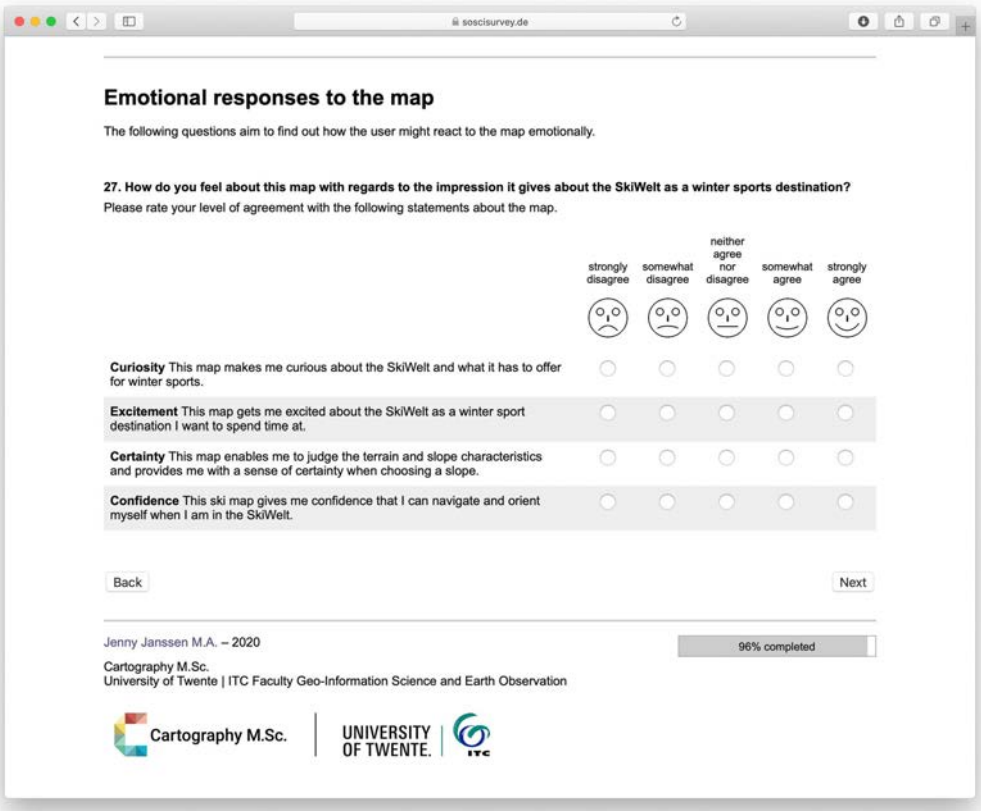
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Emotional responses to the map
The following questions aim to find out how the user might react to the map emotionally.
27. How do you feel about this map with regards to the impression it gives about the SkiWelt as a winter sports destination?
Please rate your level of agreement with the following statements about the map.
strongly disagree
somewhat disagree
neither agree nor disagree
somewhat agree
strongly agree
Curiosity This map makes me curious about the SkiWelt and what it has to offer for winter sports.
Excitement This map gets me excited about the SkiWelt as a winter sport destination I want to spend time at.
Certainty This map enables me to judge the terrain and slope characteristics and provides me with a sense of certainty when choosing a slope.
Confidence This ski map gives me confidence that I can navigate and orient myself when I am in the SkiWelt.
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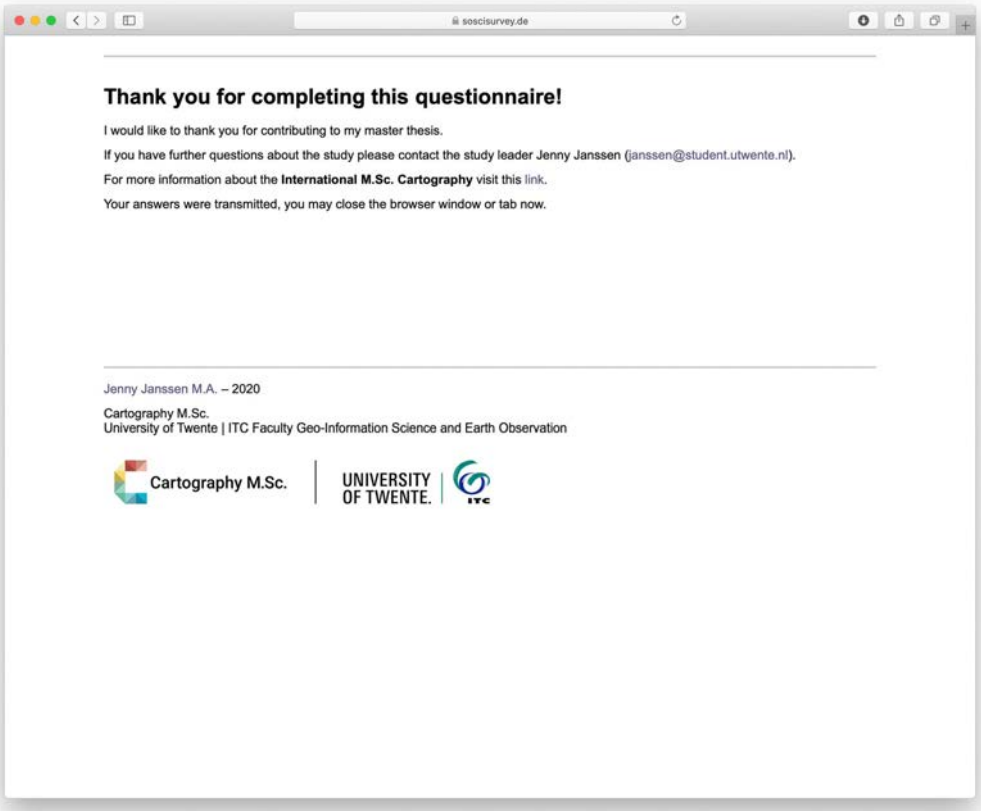
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Thank you for completing this questionnaire!
I would like to thank you for contributing to my master thesis.
If you have further questions about the study please contact the study leader Jenny Janssen (janssen@student.utwente.nl).
For more information about the International M.Sc. Cartography visit this link.
Your answers were transmitted, you may close the browser window or tab now.
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Appendix 5

Qualitative answers to Navigation and Orientation task 1

Task 1:

"Using lifts and/or slopes, how would you get from Söll to Hohe Salve?"

The following are statements made by survey participants to the question “How easy or difficult was it to answer this question?” upon completing task 1 using either Map A or Map B. The statements have been sorted into thematic groups.

Naming of lifts/ slopes unclear

Group A:

- “Description of numbers”
- “many numbers on the lift path - not sure which was correct”
- “Which numbers are lifts vs. huts or slopes?”
- “Understanding how routes/lifts are named”
- “Die Nummern der Seilbahnen entziffern und zuordnen”
- “Finden der Seilbahn-Nummern”
- "Zu viele Zahlen an den Liften”

Group B:

- “Initially unsure whether the numbers next to the lifts were actual lift numbers or capacities”

Legend was a problem/ incomplete or not in English

Group A:

- “cant speak german - but thats my fault not the maps - assuming I did Im sure it would have been easier to understand the key”
- “I had to guess that sesselift is the chairlift that takes you up as I don't speak German and there's no symbol associated with this.”
- “key was in German so took a while to understand lifts vs slopes”
- “key unclear”
- “Schwierigkeiten mit der Legend”
- “It's hard if I don't know the language”
- “legend unclear - why red symbols for lift type when sessellift is black? esp if there is a red line for a ski route”
- “The Legend is in German”

Group B:

- “Language barrier”

Unable to make connections

Group A

- “Difficult to tell if you can get to certain lifts using the pistes”
- “Many crossing paths muddle the routes”
- “Interpretation of connectivity”
- “Do I need to take several small lifts from Söll to get to the bottom of Lift 40?”
- “Whether I can assume start from the parking closest to the lifts?”
- “lots of smaller routes confused me on the overall task of getting between the two points”

Group B
- not sure where you can walk on the map/where you have to ski/take lifts”
- Determining if there was one long gondola with a bend or two separate gondolas.”

Identification of different map objects

Group A
- “I do not identify the slope labels,I only identified the lift labels”
- “Unterscheidung Seilbahn und Pisten”

Lack of experience with skiing

Group A
- “Not familiar with ski maps”

Group B
- “ich bin bisher nur 1 od 2 Mal Ski gefahren, kenne mich also mit Skigebieten/-und -karten nicht so gut aus”
- “Unfamiliar with the process of skiing”
- “Wer keine Grundkenntnisse in Bezug auf Ski hat, hat gar keine Ahnung.”

Finding the destination

Group A
- “Hohe Salve finden”

Group B
- “Finding the two locations on the map.”
- “Hohe Salve nicht so schnell gefunden”
- “Struggled to find Hohe Salve initially”

Finding the map illegible and too complex

Group A
- “Etwas unübersichtliche darstellung”
- “map is very detailed and needed to zoom in a lot to work it out, the writing for the destination town was very small”
- “viel zoomen”

Group B
- “difficulties to view all the different ways and difference them and therefore order them”

Not understanding the terrain

Group A
- “Difficult to see which height lifts are at”

Group B
- “Base elevations”

Poor resolution of the map

Group A
- “Map was not high enough resolution”

Group B
- “The slope numbers are illegible on the PDF map.”

Symbol / font size too small

Group A
- “Symbole zu klein”
- “Symbols hard to decifer”

Directions of lift/slope not clear

Group A
- “Determining which part of the slope was the highest and the lowest”
- “Direction of the lift”
- “Determining the direction of the lifts”
- “Abfahrtrichtung, Neigungsgrad usw.”
- “Vertical orientation of ski slopes”

Appendix 6

Qualitative answers to Navigation and Orientation task 2

Task 2:

"Using lifts and/or slopes, how would you get from Westendorf to Fleiding?"

The following are statements made by survey participants to the question “How easy or difficult was it to answer this question?” upon completing task 2 using either Map A or Map B. The statements have been sorted into thematic groups.

Naming of lifts/ slopes unclear

Group A

- “Working out which slope was which when trying to get to Schrandlhof (to then get a lift to Fleiding)”
- “The run numbers are confusing”
- “Heißt der Lift jetzt 8 oder 117 (Piktogramm "Lift Kapazität" irritiert) .Ich sehe erst später, dass die Gondel die Nr. 110 und 111 haben”

Legend was a problem/ incomplete or not in English

Group B

- “Not sure what is a slope versus a lift (it's in German, but I guessed)”

Unable to make connections

Group A

- “Unclear whether slope 111 connects and transitions to route 117 or whether you need to follow 117a first.”
- “Die Übergänge zwwischen Lift und Piste, sowie die Topograpie dieser Übergänge sind schwer einzuschätzen und “
- “I looked for a direct route using lifts, but it doesn't look possible so had to find a combination of lifts and skiing to get there.”
- “Are Lift 110 and Lift 111 separate?”
- “The area where Fleiding seems to be located is not directly connected with any slope/lift.”

Group B

- In that same area, I couldn't tell if slope 111 would also connect to Fleiding or if they remain separate. The lift 115a icon was covering it up.

Identification of different map objects

Group A

- “it became hard to see what were slopes vs methods of transport - the directional arrows also made me unsure if a lift only went one way - again lack of german made this hard so im sure the target demographic would find this easier. also i was 16 last time i went snowboarding so very unfamiliar with how these maps work.”

Group B
- “Bei ersten Aufgabe: Blaue Piste mit See verwechselt wegen großer Fläche."
- “IS FLEIDING AN AREA OR A PARTICULAR SPOT?”

Lack of experience with skiing

Group A
- “Not familiar with ski maps”
- “I was also unsure whether it was possible to switch to a lift part way down a slope as the map seemed to indicate, I have never skied!”
- “Not sure where one lift stops and another starts as I have never skied”

Finding the destination

Group A
- “Couldn't find the start position (poor eyesight)”
- “zoomen, Fleiding finden”
- “Fleidling finden”
- “Finding Feiding was difficult”
- “Lifts finden”

Finding the map illegible and too complex

Group A
- “Liniennetz sehr “dicht”"
- "A lot of different routes in the area”
- “map unclear”
- “Zu viele Zahlen”
- “Karte nicht klar und eindeutig”
- "Unklare Beschilderung”

Not understanding the terrain

Group A
- “Steigungen nicht absehbar”

Group B
- “Initially was going to use slope 111 but then realised that Fleiding is higher than Talkaser”
- “Elevation”
- “No height at Westendorf so unsure which direction the slope runs”

Poor resolution of the map

Group B
- “Schlechte Auflösung / Zahlen nicht gut erkennbar"
- “man kann die Pistennummern nicht lesen…”

Symbol / Font size too small

Group A
- “zu kleine Schrift”

Group B
- “Slope numbers are illegible.”
- “reading the numbers”
- “Unfamiliar symbols.”

Directions of lift/slope not clear

Group A
- "Hard to tell which slopes go down and which go up."
- “even though there is directional arrows it was a little confusing because in the image it looks uphill.”
- “same reasons as before plus it was difficult to understand which direction the lifts and slopes went”
- “Abfahrtspfeile genau verfolgen (111 sieht eher ansteigend aus)"
- “Undeutliche Richtungsweisung”

Group B
- “working out which way the slopes go”
- "I can't work out direction of the slopes”
- “Direction of ski runs”
- “WHICH WAY IS UP ON THE SLOPES?"
- "not sure of direction of slope”
- "Direct route not exactly clear”
- “Determining whether the slopes go uphill or downhill.”
- “Hard to determine the direction of the slope in some areas.”
- “Direction of lift”
- “war erst nicht klar, ob Lift 115a auf den Fleiding hochfährt (tut er aber glaube ich nicht)”
- “Bei zweiten Aufgabe: Unklar ob Piste/Lift bergauf/bergab geht.”
- "The only lift between Fleiding and Talkaser appears to run in the downhill direction according to elevations. Seems like you might have to ski down to 117 and take the lift back up.”

Lack of accuracy

Group A
- “The exact location of Fleiding is unclear.”
- “ungenaue Position des Endziels"
- “Not confident that route is correct due to not exact start and finish of start/finishes of slope and lift routes"
- "Slopes/lift in that area do not have one single endpoint that can be used for reference."
- "Lift 110 and 111 not clear finish/start”

Group B
- “Unklarer Pistenverlauf am Grat (?) nach Fleidin"

Label position

Group A
- “Label "Fleiding 1892m" nicht eindeutig einem Berg zuordenbar”
- “Unclear where the Fleiding destination is. Is it at the top of Lift 117? At the bottom of lift 115a?”
- “Hard to tell where Fleiding was. I found the label, but it was difficult to determine where the peak was, or what part of that area you wanted me to navigate to.”
- “the fleiding label wasn't placed easy”

Appendix 7

Qualitative answers to Navigation and Orientation task 3

Task 3:

"Using lifts and/or slopes, how would you get from the Brandstadl peak to hut 4?"

The following are statements made by survey participants to the question “How easy or difficult was it to answer this question?” upon completing task 3 using either Map A or Map B. The statements have been sorted into thematic groups.

Naming of lifts/ slopes unclear

Group A

- “Zugehörigkeit der Blauen Linien zu den Pistennummern schwer erkennbar”

Group B

- "Telling which slope is which, when they're all next to each other”

Legend was a problem/ incomplete or not in English

Group B

- “no legend on the map”

Unable to make connections

Group A

- "Unclear whether the slope between 66a and Lift 71 is a continuation of slope 66"
- “After lift 64,lift 68, I couldn't figure out the next steps"
- "Couldn't find a route of slopes/lifts that joined up to get to Hut 4"
- “the route was not very direct, it seemed most routes were out of rather than into Zinsberg"
- “Absolut unklare Richtungsweisung”
- "Sometimes is is hard to tell whether it is possible to transfer from one lift to another”
- “war mir nicht sicher, ob am Ende Lift 67/68 ich rüber auf Piste 2a kann oder nochmal liften”
- "Can I get from the top of lift 71 to slope 2a?”
- “I wasn't sure if Hut 4 was accessible from both Slope 2a and Slope 6”

Group B

- “Difficult to understand the transition from blue to red slopes in large areas, e.g Slope 65a and Slope 67, is this a ridge, or a continuous slope?”
- “can't see connections easily”

Identification of different map objects

Group B

- “Auswahl Weg vom Zinsberg zur Hütte”

Finding the destination

Group A

- “find facilities”
- “Couldn't find hut 4”
- "Finding the place names and hut number”
- “Hütte 4 finden”
- “Hütte 4 finden”
- “To find hut 4”
- “Where is Brandstadl?”
- “I could not find Hut 4 on the map”
- “I couldn't find the hut”
- “Habe die orte gar nicht gefunden”
- "hut 4 took a bit to find"
- “Hard to find Hut 4”

Group B

- "I couldn't find hut 4”
- “Finden von Hütte 4”
- “finding some names"
- “finding hut 4”

Finding the map illegible and too complex

Group A

- “die Karte ist reichlich überfüllt, auf einer kleinformatigen Ausgabe nicht gut lesbar"
- “so many lines and numbers - not sure which was which"
- "Slopes cross each other“
- "too many lines make it visually busy in that area”
- “Many small routes”
- “I was confused which slope was which where some of them merged or weren't labelled”
- “Ein wirklich durchgängiger Weg isst kaum zu erkennen, ebenso Steig- und Gefälleestrecken. Der Schwierigkeitsgrad der Pisten ist für mich schon problematisch”
- “map unclear”
- “Lots of crossing flows make it hard to locate and keep track of the best path.”
- “There is a high density of lifts and slopes between the two points."
- “Same as before, difficult to see if it's possible to get to a lift using certain slope"
- “Too many routes/options"
- “Many different routes"
- “Total unübersichtlich”
- “Besser wäre einzelne karten nach Schwierigkeit getrennt, dann Übersicht klarer”
- “beim Überprüfen etwas durcheinander, ich wollte schon den Bus nehmen - aber wo ist der?”
- “Zu viele Nummern und zahlen”

Group B

- “lots of symbols and numbers crowded in one area”
- “i struggle naming all the different ways possible”
- “Lots of different slopes intersecting makes determining direction more difficult without markers on the map.”
- “Many possible routes.”
- "Takes several lifts and slopes to get from start to finish.”

Not understanding the terrain

Group A
- “Is there a flat trail linking the bottom of slope 66 to lift 71?"
- “fehlende Steigungsangabe bei Lift/Piste”

Group B
- “Can't determine elevation difference to know when to use a lift, or a slope”
- “Don't know the height of the lift tops so hard to tell whether the route will work”
- “In this area with three peaks of very similar heights (Brandstadl, Eiberg, Zinsberg), it was difficult to tell which areas between them were uphill and down. I had to study the lift locations and directions in order to infer slope angle and aspect. Even after studying it closely, my answer was still kind of a guess. For example, with slope 65a, is it downhill all the way from Zinsberg to lifts 67/68?”
- “tough to tell uphill v downhill”
- “few data of altitude”

Poor resolution of the map

Group A
- "Difficult to make out the slope numbers due to pixelation on zoom”
- “Karte ist zu unübersichtlich bei meiner Auflösung”

Group B
- "Ich kann nicht die Nummer der Piste sehen, obwohl ich diese Übersichtskarte der Skiwelt auf dem Computer sehe.”
- “last run 1a ? .. couldn't read it"

Symbol / Font size too small

Group A
- “Hüttennummern zu klein”
- “schlechte Lesbarkeit der Nummern”

Group B
- “much too small letters (.. beside extreme big letters)”

Directions of lift/slope not clear

Group A
- “It's sometimes hard to understand the orientation of the ski slopes between Brandstadl and the hut.”
- “Determination of direction of slope of pistes/lifts not always intuitive"
- “It is difficult to tell which way is down hill in some areas.”
- “Nicht alle Pisten haben Richtungsangaben, denn man kann ja nur nach unten fahren. ;-)”
- “Unclear markings on piste slope direction (eg. blue piste between lift 66 and 71)."
- "Understanding slope direction”
- “I was confused by the slopes which had arrows in both direction”
- “Some slopes didn't have direction”

Group B

- “couldnt work out directions of slopes”
- “Very difficult to determine slope direction between Eiberg and Zinsberg”
- “Unklar ob Pisten und Lifte hinauf oder hinunter gehen. Wie man demnach von einer Bergstation zum nächsten Lift kommt.”
- “Direction of slopes unclear.”
- “Determining uphill or downhill on the slopes.”
- “Hard to tell what the direction or amount of slope is.”
- “Slope direction”
- “difficukt to tell direction of slope”
- “Determining if the the lifts go or up or down.”
- “Telling which direction is down or up”

Label position

Group A

- “Not always clear which number applies to which slope”

Group B

- “Telling where the peak is exactly (or even that Brandstadl is a peak)”
- “Where actually is Brandstadl? Do I need a slope before lift 65?”

Lack of labels

Group A

- “Some slopes didn't have visible numbers”
- “Number missing from map for one of the slopes”
- “One of the slope has no number”
- “The slope from Eiberg to lift 70 is not clearly numbered”
- “Complete labeling of slopes to get from Hut 30 to Hut 4 was challenging."
- “no label on the slope passing over hut 42 at Eiberg, assuming its 59(1), considering the 2nd above it in same direction is 59(2)”
- “Nummerierung nicht vorhanden”
- “Some slopes weren't named”

Logic of naming

Group A

- “Hut numbers do not seem to follow an intuitive order"

Choice of slopes according to ability

Group A

- “Didn't want to use a difficult slop as a beginner”

Appendix 8

Counts of qualitative answers to Navigation and Orientation tasks 1 to 3

	Task 1 Group A	Task 1 Group B	Task 2 Group A	Task 2 Group B	Task 3 Group A	Task 3 Group B	**Total Group A**	**Total Group B**	**Total All groups**
Naming of lifts/ slopes unclear	7	1	3	0	1	1	**11**	**2**	**13**
Legend was a problem/ incomplete or not in English	8	1	0	1	0	1	**8**	**3**	**11**
Unable to make connections	6	2	5	1	9	2	**20**	**5**	**25**
Identification of different map objects	2	0	1	2	0	1	**3**	**3**	**6**
Lack of experience with skiing	1	3	3	0	0	0	**4**	**3**	**7**
Finding the destination	1	3	5	0	12	4	**18**	**7**	**25**
Finding the map illegible and too complex	3	1	6	0	17	5	**26**	**6**	**32**
Not understanding the terrain	1	1	1	3	2	5	**4**	**9**	**13**
Poor resolution of the map	1	1	0	2	2	2	**3**	**5**	**8**
Symbol / font size too small	0	2	1	3	2	1	**3**	**6**	**9**
Directions of lift/slope not clear	0	5	5	12	8	10	**13**	**27**	**40**
Lack Of Accuracy	0	0	5	1	0	0	**5**	**1**	**6**
Label Position	0	0	0	4	1	2	**1**	**6**	**7**
Lack of labels	0	0	0	0	8	0	**8**	**0**	**8**
Logic of naming	0	0	0	0	1	0	**1**	**0**	**1**
Choice of slopes according to ability	0	0	0	0	1	0	**1**	**0**	**1**

Appendix 9

Expert questionnaire completed by Stefan Grafl

Expertenbefragung

Diese Expertenbefragung erfolgt im Zuge einer Abschlussarbeit für den Cartography M.Sc.

Ich, Jenny Janssen, Studentin der University of Twente (NL) und der Technische Universität München (DE) schreibe derzeit meine Abschlussarbeit zu folgendem Thema:

Exploring alternatives to the ski panorama

Evaluating the affordances of different cartographic depictions of mountainous ski areas.

Die folgenden Fragen und deren Antworten werden ausschließlich für diese Abschlussarbeit verwendet und können in dieser in voller Länge wiedergegeben werden, um die Forschungsfragen zu beantworten.

Die folgenden Fragen beziehen sich ausschließlich auf den oben gezeigten SkiWelt SkiMap.

Die Antworten können entweder direkt in dieses Dokument eingefügt oder in einem separaten Dokument geschrieben werden.

Ich bedanke mich vielmals für Ihre Zeit und Mithilfe.

Datum: 4. Juli 2020 Unterschrift:

1. Anfertigung der SkiWelt SkiMap

1.1. Welche Schritte werden benötigt, um die SkiMap anzufertigen? Eine grobe Auflistung der Schritte genügt.

- *Festlegung der Kartenvariante (z.b. Orthophoto, gemalte Variante ect…)*
- *Festlegung der Schwerpunkte (Welche Objekt/Anlagen sollen dargestellt werden)*
- *Akquise der Infrastruktur bei den Partnern (Bergbahnen, Verkehrspartner…)*
- *Erfassung der Punkte und Einzeichnen dieser*
- *Kontrolle und Freigabe durch die Partner*

1.2. Von wem und wann wurde das Bergpanorama, das der SkiMap zugrunde liegt, angefertigt?

Frau Schultus

1.3. Wurde das Bergpanorama speziell zur Darstellung von Wintersportinformation angefertigt?

Ja. Die Grafik wurde auf den Wunsch der SkiWelt gezeichnet.

2. Gestaltung der SkiWelt SkiMap

2.1. Basiert die Darstellung der Kartensymbole auf Gestaltungsrichtlinien der SkiWelt oder auf externen Richtlinien wie zum Beispiel der ÖNORM?

Auf Grundlage der SkiWelt.

2.2. Welche Kriterien liegen der Gestaltung der verwendeten Schriften, Farben und Größen zugrunde?

Dem SkiWelt Winter CI

3. Inhalte der SkiWelt SkiMap

3.1. Worauf beruht, und wie wird die Auswahl der dargestellten Inhalte getroffen?

Wichtigkeit für Skifahrer und Nutzer des Skigebiets. Orientierung und Übersicht des Skigebietes. Darstellung der Infrastruktur.

3.2. Gibt es besondere Regeln, die bestimmen, welche Inhalte gezeigt beziehungsweise nicht gezeigt werden?

Die hängt von der Wichtigkeit für den Nutzer des Skigebietes ab. Nichtrelvante Inhalte werden nicht vermerkt.

3.3. Worauf beruht die Nummerierung der Pisten, Liftanlagen und Hütten?

Nummern der Pisten und Liftanlangen werden von den Bergbahnen vergeben, wobei jeder SkiWelt seinen eigenen Nummernkreis hat. Ebenso die Hütten. Diese Nummernkreise wurde bei der Fusion der unterschiedlichen Bergbahnen zur SkiWelt Wilder Kaiser – Brixental festgelegt.

4. Zweck(e) und Zielgruppe(n) der SkiWelt SkiMap

4.1. Was ist/sind der/die Verwendungszweck(e) der SkiMap?

- *Haptisch/Gedruckt*

  Für Einbindung in Infobroschüren, auf Übersichtskarten- und Tafeln in der Region und im Skigebiet. Als Bereitstellung für Drucksorten von Partnern wie TVB´s, Vermieter und Presse.

- *Online: Als Grundlage für die Onlineskimap welche zur Navigation und Orientierungshilfe im Skigebiet dient.*

  Als Einbindung zur Übersicht in zahllosen Onlineportalen (Bergfex, Snowplazza…..). Bereitstellung zur Einbindung auf Webpages, IFrames, und zur Darstellung bei Partnern (TVB´s, Vermietern, Verleihpartnern, Skischulen, Sporthändlern….)

4.2. Wer ist die Zielgruppe der SkiMap?

- *Tagesskifahrer der SkiWelt Wilder Kaiser – Brixental*
- *Urlauber der umliegenden Tourismusregionen Kufsteinerland, Wilder Kaiser, Kitzbüheler Alpen Brixental, Kitzbüheler Alpen Ferienregion Hohe Salve*
- *Gleitschimflieger*
- *Winterwanderer welche die Aufstiegshilfen der Bergbahnen nutzen*
- *Langläufer der Höhenloipe Hochbrixen.*

5. Vertrieb und Verfügbarkeit der SkiWelt SkiMap

5.1. Wie wird die SkiMap vertrieben?

Kostenlose Bereitstellung der Daten an alle Nutzer durch die SkiWelt Marketing GmbH. Es ist keine kommerzielle Nutzung außerhalb der Nutzungsbereiches der SkiWelt sowie der touristischen Partnern (TVB´s, Vermieter, Sporthändler) vorgesehen.

5.2. Wo ist die SkiMap für den Nutzer im Skigebiet sichtbar und/oder erhältlich?

Siehe Punkt 4.1.

6. Rückmeldungen zur und Aktualisierung der SkiWelt SkiMap

6.1. Gibt es Rückmeldungen zur SkiMap? Wenn ja, welcher Art?

Positiv in der Darstellung und Einbindung der Filterfunktionen

6.2. Gibt es wiederkehrende Kommentare oder Wünsche?

Die optische Darstellung einiger Bereiche welche „hinter“ den Bergen liegen ist ab und an für einige Benutzer nicht klar. Wir lassen gerade eine neue Grundkarte malen. Hierbei sollen diese Punkte gelöst werden.

6.3. Von wem kommen Rückmeldungen und in welcher Form?

Laufende währende der Saison von Nutzern, Vermietern und den Bergbahnen. Auch bringen die Experten vor Ort wie Skischulen Ihre Knowhow mit ein.

6.4. Wird die SkiMap regelmäßig aktualisiert? Wenn ja, in welchem Intervall?

Die gedruckten Varianten werden halbjährliche überarbeitet. Die Onlineversion wird laufend aktualisiert.

6.5. Wenn ja, in welchen Abständen wird sie aktualisiert/geändert?

Siehe 6.4.

6.6. Welche Elemente werden üblicherweise aktualisiert?

Alle Punkte bei denen es zu Änderungen kommt. Es werden bei jeder Überarbeitung alle Punkte überprüft.

6.7. Werden Änderungen am gemalten Bergpanorama vorgenommen?
Wenn ja, wann fand die letzte Änderung statt, und was wurde geändert?

Für 2021 ist eine neue Version vorgesehen.

7. Zukünftige Pläne für die SkiWelt SkiMap

7.1. Gibt es Überlegungen oder Pläne die SkiMap grundlegend zu ändern?

Das Grundkonzepte einer Übersichtskarte wird beibehalten und stetig weiterentwickelt.

7.2. Gibt es Überlegungen oder Pläne zusätzlich zur SkiMap weitere, andere Skikarten zu erstellen und anzubieten?

Eventuell wird dieses Model auf den Sommer übernommen. Im Moment prüfen wir hierzu noch die Möglichkeiten.