Orienteering in Lockdown Condition – Tools for Training Support

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ABSTRACT
Introduction: The current times are influenced globally by the application of anti-epidemic measures to combat COVID-19. These are applied to varying degrees or an extent, but the common denominator is the frequent impossibility of running mass sports events. Sport or physical activities are thus suppressed, which is reflected in a decrease in physical activity and, therefore the condition of the population (Eurostat, 2020). Furthermore, the adverse effects of hypokinesis on an individual's health are documented in detail in the literature and generally accepted as a fact (Araújo, & Mesquita 2019; Vedukhina, Lobygina, & Sharapova, 2016).
Aim: This study aims to summarize and compare available applications that allow individuals to undergo physical activity based on the content of the sports industry, which is orienteering, while respecting the limitations of pandemic restrictions aimed mainly at preventing the gathering of more people.
Methods and Materials: Theoretical methods were used, especially the descriptive and comparative methods. Many foreign sources and manuals related to individual applications were analyzed. User evaluation of these applications on web platforms was also taken into account. The described applications were assessed within an expert panel who assessed and evaluated the individual platforms within a uniform methodology. Pairwise comparison was used as a research technique.
Results: The result is a summarizing and comparative overview of individual applications, enabling the implementation of an activity based on the principle of orienteering through digital technologies and respecting the limits that come with anti-pandemic restrictions, especially at the level of potential contact in gathering multiple people. The iOrienteering platform is evaluated as the most practical application; the MOBO application is the opposite end of the assessment scale.
Conclusion: The iOrienteering and O-range applications were evaluated as the most beneficial according to the specified criteria. The applications under consideration are suitable for use under the current movement-restricting regime resulting from pandemic restrictions.
Key words: digital technology, lockdown, mobile applications, orienteering

SOUHRN
Úvod: Současná doba je celosvětově ovlivněna aplikací protiepidemických opatření v rámci boje proti onemocnění COVID-19. Tato jsou uplatňována v různé míře či rozsahu, společným jmenovatelem je však častá nemožnost provozování hromadných sportovních akcí. Sport či pohybové aktivity jsou tímto utlumeny, což se v důsledku projevuje poklesem fyzické aktivity, a tedy i kondice obyvatel (Eurostat, 2020). Negativní dopady hypokineze na zdravotní stav jedince je v odborné literatuře podrobně zdokumentován a jako fakt všeobecně přijímán (Araújo, & Mesquita 2019; Vedukhina, Lobygina, & Sharapova, 2016).
Cíl: Cílem této studie je sumarizovat a komparovat dostupné aplikace, které umožňují absolvovat jedinci pohybovou aktivitu, vycházející svým obsahem ze sportovního odvětví, kterým je orientační běh a při tom dodržet omezení vyplývající z restrikcí v rámci pandemického stavu mířící zejména k zamezení shromažďování více osob.
Metody: Využity byly metody teoretické, zejména metoda deskriptivní a komparativní. Analyzovány byly namnoze zahraniční zdroje a manuály vážící se k jednotlivým aplikacím. V potaz též bylo bráno uživatelské hodnocení těchto aplikací na webových platformách. Popisované aplikace byly posouzeny v rámci panelu expertů, kteří jednotlivé platformy posuzovali a hodnotili v rámci jednotné metodiky. jako výzkumná technik bylo využito párové srovnávání
Výsledky: Výsledkem je sumarizující a komparativní přehled jednotlivých aplikací, umožňující realizovat aktivitu vycházející z principu orientačního sportu prostřednictvím digitálních technologií a respektující limity, která sebou přináší protipandemická omezení, a to zejména v rovině potenciálního kontaktu v rámci shromažďování vícero osob. Jako nejpřínosnější aplikace je vyhodnocena platforma iOrienteering, na opačném konci posuzovací škály je aplikace MOBO.
Závěr: Jako nejpřínosnější dle zadaných kritérií byly vyhodnoceny aplikace iOrienteering a O-range. Posuzované aplikace jsou vhodné pro použití za současného, pohyb omezujícího režimu, který je důsledkem protipandemických opatření.
Klíčová slova: digitální technologie, lockdown, mobilní aplikace, orientační běh,

INTRODUCTION

The beginning of 2021 is marked by a worldwide fight against the pandemic spread of COVID-19. Among the measures applied by individual governments is a greater or lesser form of limiting the risk gathering of persons and restricting their mobility, whether within a municipality, region, state, or country. Area quarantine measures vary from an absolute "lockdown" to the definition of a perimeter in which an individual or several persons are allowed to move freely at once. For example, in the spring of 2020, Italy restricted population movement for one month, Israel at the beginning of fall 2020 a perimeter of 500 meters for unrestricted movement, and in February 2021, the German population was allowed to move within 15 km of the place of residence. The Czech government adopted a similar plan to restrict movement within districts and the cadaster of residence. It also limits the number of people who can be

in contact at one time. This is also one of the main obstacles to organizing mass sports events or even practice.

In our paper, we want to focus on the problem of how to organize and perform physical activity, explicitly orienteering in these limiting conditions, because organizing a mass event to which the organization of a race or practice in orienteering is not possible for the above reasons.

Although orienteering is an individual sport in a natural environment, people's contact during the racing or training activity itself is minimal, but the logistics of organizing a practice or race, to a large extent, require contact. The race or practice usually has a designated meeting place, where the participants present themselves and read the chips after the race with the recorded passage through the individual checkpoints, the start, and place with issuing maps is again a risky location with the start and place with issuing maps the potential for unwanted contact. In addition, tens to hundreds of participants usually attend local events or practices such as winter leagues, a regular race at the regional level of thousands, not to mention international multi-day races, where the number of participants reaches several thousand in all age categories.

Through digital technologies and suitable applications, it is possible to organize an orientation race in a "remote form", while individual solutions use a different approach and methodology. Our work focuses on capturing these differences, comparing and summarizing the devices used in individual applications.

MATERIAL AND METHODS

To obtain individual applications, we studied the web presentations of providers, and according to the degree of relevance to the goal of our work, we selected five applications, which we tested in practice through an expert panel. The criteria according to which the products were evaluated were as follows:

- availability (commercial / non-commercial)
- installation (easy / challenging)
- system requirements (including iOS / Android support)
- user interface (user friendly / more complex control)
- practical applicability
- data connection requirements
- versatility (possibility of creating more types of trainings – “scorelauf” / one-man relay / etc.)

The pairwise comparison method was used to determine the order (Havel, & Hnízdil, 2008). In the dichotomous classification using the eight above criteria, members of the expert panel compared five applications. We then arranged the data obtained from all members into a matrix *f*, whereby the used method, the value f_{ij} (i = row, j = column), represented the frequency with which the given application was evaluated better. Furthermore, within the matrix *p*, the values were converted to

relative frequencies according to $p = \frac{f_{ij}}{n}$. Subsequently, the probabilities of p_{ij} were converted to *z - points* using the critical values of the normalized normal distribution function, and a matrix *z* was created. Finally, the arithmetic means of the column values were corrected by adding the highest negative value to eliminate negative numbers. The highest value thus indicates the best-rated application.

EXPERT PANEL

The expert panel was composed of nine experts – coaches and active athletes in orienteering from the following sports clubs: OK Jiskra Nový Bor (2) Slavia Liberec Orienteering (1) OOB TJ Turnov (2) SK Haná Orienteering (1) KOB Kamenický Šenov (2) KOB Děčín (1). Three experts hold a coaching license in orienteering, two are members of the national team of the Czech Republic, and another three have a judge's license for competitions in orienteering. Everyone was provided with data for the installation of individual applications and was asked to test them in practice within one month.

In addition to filling in the dichotomous matrix for comparing applications according to the specified criteria, experts were asked for written comments and opinions on the individual systems tested.

RESULTS

In our research, we assessed the following selected applications:

- iOrienteering
- MOBO
- UsynligO
- GPS orienteering
- O-range

Within the overview, we present brief characteristics of individual applications:

iOrienteering (https://www.iorienteering.com/)

Author R. Patton's application, available from https://www.iorienteering.com, works on the principle of placing a physical checkpoint in the terrain in the form of a QR code, which the competitor scans to his or her mobile phone via an installed application (available for free for iOS and Android). The system makes it possible to measure the time of the race/training and check whether the rules have been followed (fixed or free order of checks). The competitor may not have access to the data connection during it. The organizer first registers in the system and then has the opportunity to prepare the track. The system itself will then generate the necessary QR codes. The track builder prints them out and distributes them to the terrain. The competitor with the mobile phone with the application installed will run the whole course; he or she only scans the placed codes at the checkpoints. An internet connection is only required to download the application and, after completion, to upload the results (Hnízdil, Vojtíková, & Vařeková, 2020).

Athlete's procedure:

1) Download the installation and log in to the iOrienteering application on the mobile phone (data connection required), move to the starting position
2) Scanning of the QR code on the map or a separate sheet for loading a specific orienteering race (already fully offline)
3) Scanning the start QR code and the actual start
4) Gradual achievement of individual checkpoints (according to the assignment - free or fixed order of checks) and self-service scanning of the QR code at each checkpoint
5) Scanning the target QR code after reaching the goal of the race
6) Upload results and view them on iorienteering.com (data connected required)

(Hnízdil, & Heidler, 2020)

MOBO (https://mobo.osport.ee)

The author of this application, Estonian developer Tarmo Klaar, states on his website: "MOBO is a modern way of training orienteering. For orienteering runners, the smartphone is a "3-in-1" device with a map, compass, and a device for recording the inspection passage, all in one package. Maps in a mobile phone are standard maps for orienteering, and therefore basic skills of terrain orientation and map reading are necessary to manage the track successfully. The built-in compass shown on the phone display is used for orientation. In addition, there are special marks with QR codes at the checkpoints. Information about passing checkpoints by scanning the QR code to the smartphone is sent to a server where user statistics can be seen. The MOBO application is developed for local areas of fixed checkpoints, but with the help of this platform, an outdoor orientation event can be organized for anyone and anywhere. The first MOBO complex was opened on 1 January 2012 in the Estonian city of Keila" (MOBO, 2020).

Athlete's procedure:

1) Install the application on the phone. It is free for Android, iPhone/iPad, Windows Phone, and Nokia (Symbian).
2) Select the name of the track/map and wait for the map to download to the phone. Then, use the map and the built-in compass shown on display to search for checkpoint/s.
3) To stamp the checkpoint - select "Stamp" from the application menu (or press the [Photo] button) and take a photo of the QR code. The successful stamp of the checkpoint will be sent to the statistics server. After completing the track, the feedback can be provided on the application's information website.

UsynligO (https://usynligo.no)

The application's name by the author Trond Benum from Norway can be translated as "invisible orienteering". Unlike the previous systems mentioned above, it

is based on the absence of a physical marking of the checkpoint in the terrain. This is replaced by a virtual and mobile phone application via GPS, and then an audible signal informs the athlete if he or she is in the correct position in the terrain. The distance and direction to the checkpoint can also be tracked in the help. The application also includes a compass and the ability to display a map on a mobile phone screen. However, unlike the previous application, a permanent data connection is required throughout the race/training (UsynligO, 2020). Another limit maybe the quality of the GPS signal.

Athlete's procedure:

1) Install the application on the phone. It is free for devices: Android, iPhone from their online stores
2) It is possible to log in to the application using one of three options: Google, UsynligO, or Anonymous to create a user account. In the Anonymous variant, it is not possible to publish the results in the results list.
3) Select the name of the track/map and wait for the map to download to the phone. The use of the map and the integrated compass are shown on display. It is possible to visit the "error radius" to consider possible GPS inaccuracy when tracing the inspection.
4) Finding the correct control is indicated by an acoustic signal. With a different signal, the application also announces the achievement of incorrect checkpoints (other lines, checkpoints in the wrong order).
5) After completing the activity, it is possible to send the results to the server for comparison with other athletes.

GPS Orienteering (hhtp://hippsomapp.se)

The essence, i.e., a virtual checkpoint without physically placing them in the terrain, is identical to the previous application. In contrast, it offers more advanced features. This is also related to the fact that in the full version, which is a necessity for builders/organizers, it is paid (approx. CZK 100). The athletes will be satisfied with the lite version of GPS Orienteering Run, which is free. Tracks with a map are uploaded to the application from the web interface, where they are protected by a code and password, unlike the UsynligO application, where they are public. GPS will record the athlete's position, and when he or she runs to the checkpoint, the checkpoint responds with an acoustic signal. After running to the finish line, all procedures, split times can be seen, and after uploading the data, it is possible to compare individual athletes. The application is intended only for Android devices (Google Play) and is compatible with the FOOD application (GPS orienteering, 2020).

The athlete's procedure is similar to the previous application.

O-range (https://www.storler.no/orange)

The principle of virtual checkpoints, i.e., the ability to prepare training without a physical visit of the terrain, is the essential feature of this application. Unlike the

previous two, it is not installed in a mobile phone, but Garmin watches, in virtually all models with GPS and the ability to upload third-party applications. The current list of compatible devices includes 50 models, including the popular Fenix, Forerunner, and Vivoactive series. The application of the Norwegian developer Atle Pedersen is free; of course, it is possible to create own tracks and training and then offer them to the public in the "Public courses" section. The implementation of the race or training is similar to previous applications; instead of a mobile phone, a Garmin watch (O-RANGE, 2021) informs us about the achievement of the correct checkpoint with an acoustic signal.

Athlete's procedure:

1) Install the application on a Garmin device
2) Creating an account on the O-Range website
3) Pair the Garmin device with an account
4) Download tracks to Garmin device - Livelox or O-Track platforms can be used as an equivalent
5) Download and print the map
6) Start the activity

Table 1 lists all assessed applications in the order as they were assessed according to individual criteria by individual members of the expert panel (see methodology).

Table 1 *The resulting corrected values of the column diameters of the matrix z for individual applications:*

Application	Points
iOrienteering	1.73
O-Range	1.16
UsynligO	0.95
GPS orienteering	0.12
MOBO	0

Note: The highest value indicates the best-rated app

DISCUSSION

Based on the overview we have created, we can divide the available applications into two categories despite several common aspects and functions. On the one hand, these are applications whose essence is the physical placement of marking of control

stations in the terrain (MOBO, iOrienteering). On the other hand, applications that can be marked as virtual, i.e., the builder (organizer), are not required to physically attend the terrain (GPS orienteering, UsynligO, O -Range). However, this concept of structuring is sustainable only on a theoretical level. It can be used for fundamental division, but from the practice of builders of orientation training and competitions, it is known that each builder, although he/she has the opportunity to "build" a checkpoint virtually, in practice will still use the opportunity to visit the place in the terrain. The reason is the effort for proper race/training, i.e., the effort is to check that the current situation in the terrain corresponds to the state of the map data. The higher the age of the map, the more urgent it is to physically visit the race/training area and correct the location of the checkpoints compared to the concept prepared at home.

Another possible factor according to which it is possible to divide the available applications is a GPS. This system is necessary for the operation of GPS orienteering, UsynligO, O-Range applications. It can be used, but iOrienteering does not need to work. The use of the GPS is also associated with its accuracy in specific conditions and terrains. To refine the positioning data, in addition to the standard considered to be the American GPS, the technologies allow the use of the European Galileo system or the Russian GLONASS. This is often linked to the type and quality of the mobile phone or similar device used and unrelated to the applications. However, the applications offer to some extent the inaccuracy of positioning to be corrected within the possibility of setting a specific radius in which the system still considers the achievement of the checkpoint to be successful (e.g., 15m). This should be taken into account in elevated terrains; use in urban areas is, in our opinion and experience, burdened by a higher degree of unreliability.

One of the aspects that may have seemingly influenced the evaluation of the experts within the expert panel is the question of the builder's/organizer's point of view and the competitor's/training person's point of view. In orienteering, however, both of these roles are combined, and it can be stated that the builder in his work tries to "slide" into the feelings of the competitor and the competitor in tactics and mind of the builder, which affects and determines the track. All members of the panel we contacted are active competitors, and at the same time, half of them are also builders of successful national and international races and events. The second half of the experts also has experience with the construction of training and local races. Therefore, we can state that with the expert choice of the members of the expert panel, we took into account the view of both the builder and the competitor on the submitted applications.

Discussion on the final evaluation of individual applications within the expert panel:

Representatives of both categories defined above appeared in the first two evaluation places, i.e., the highest-rated iOrienteering application using the principle of physically located checkpoints in the terrain and the O-range application based on the second on virtual checkpoints achieved. This application is placed at the top in the "category" of virtual checkpoints, and it is possible that because it is not the only one tied to the use of a mobile phone in the activity. It is installed in a watch that athletes

commonly use in orienteering races and training. This may consider some of the discomfort associated with using a mobile phone while running and moving in the terrapin. There is always a risk of falling and possible damage to this mobile technology.

For the best-rated application (iOrinteering), which is based on the principle of scanning QR codes when passing through the checkpoint, the judges especially appreciated the user-friendly environment within the application and web interface for creating both QR codes and preparation and implementation during races or training. On the other hand, for the MOBO application, which is very similar in principle, the reason for its negative evaluation, which in the sum meant the last place, was probably the fact that to create the track and generate QR codes, it is necessary to contact the creator of the application and request his or her consent.

In our opinion, both iOrienteering and MOBO applications are suitable not only for one-off training events but especially for permanent use in the so-called fixed control areas. The added value of the MOBO application is the possibility to use contactless NFC technology when marking the passage through the checkpoint. This eliminates a certain discomfort when conventional QR code scanning, affecting the quality of the integrated camera and the lighting conditions or QR code print quality. Furthermore, if we use the lamination of these codes, the reflection of light can make it difficult to read them correctly. Our experience shows that the best distance between the QR code and the phone to "stamp" the control is about 20-50 cm, but it depends on what program is used to read QR codes (applies to the MOBO application) and on external conditions.

A prerequisite for the correct use of the compass in applications that allow it is its calibration, optimally after switching on the phone. In addition, the sensors may require regular recalibration. To calibrate, it is necessary to follow the instructions, usually holding the phone in front and moving it in the figure-eight symbol.

CONCLUSION

Ideal application from the competitor's point of view: Physically checkpoints are located in the field, and passage through them can be realized through wireless technology, optimally placed in a wristwatch.

Ideal from the builder's / organizer's point of view: There are no physically located checkpoints in the field, the correct passage is recorded via a quality (accuracy 5m) GPS signal, and immediately after the finish, the race/training is uploaded to the server, where compliance with the rules and competitor/trainer is automatically evaluated. This is included in the relevant result list to compare the results, including individual split times. (Hnízdil, Vojtíková, & Vařeková, 2020).

These applications are suitable for organizing orienteering activities in conditions affected by restrictions on free movement or the possibility of gathering more people.

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