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Original Article

Towards a method to support trail selection for the outdoor movement education process

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Abstract
Outdoor education has recently been proposed to support multidisciplinary learning processes developed in a natural environment. In this sense, several studies have addressed the pedagogical perspective of this educational model, while little evidence has been provided onthe level of suitability required to identify an outdoor educational environment. The aim of this study was to propose an assessment method that can be used to verify whether a specific pathway can be chosento develop educational activities. The main focus remains on how natural resources can be taught more effectively in the school setting, particularly in physical education processes. In a holistic approach, several reasons support the need to use the external context during the teaching-learning processes of PE in order to act positively on the psychomotor, cognitive, and socio-affective domains.Therefore, several reasons support the need to use the external environment during the PE teaching-learning processes. On the contrary, a problem that many teachers have to face is relating to the choice of the most suitable path to support physical education processes. We try to enhancethe method proposed by Di Felice to support hikers in choosing a path, with an approach that has the prerogative to fit within into a frame of ecological dynamics.The current method may guide a teacher when he/she plans an outdoor education learning process in a double perspective: a) to classify outdoor paths according to their physical characteristics and academic aims; b) to match each path with the learning characteristics associated witha physical education plan developed by following the outdoor learning model.
Keywords: **Hiking; Physical Education; Sport Education; Ecologic Dynamics; Nonlinear pedagogy**

Introduction

Martin and McCullagh (2011) debated the relationship between Outdoor Education (OE) and Physical Education (PE). They pointed outthat several studies have indicated the two disciplines as interchangeable, meanwhile,they argued that these are complementary but discrete disciplines. Specifically, according to the Australian primary school curricula, Physical and Outdoor Education have different learning objectives and, althoughOE is often taught by Physical Educators, teachers of these disciplines must havea different formal qualification. As such, PEaims in primary school are mainly focused on the development of fundamental movement skills, motor competencies, and game-play knowledge (SchembriQuinto, Aiello, Pignato, &Sgrò, 2019; Sgrò, Quinto, Platania, &Lipoma, 2019; Invernizzi et al., 2020) with the purpose of increase physical health and wellbeing throughout physical activity. OE is most focused to establish a relationship between humans and nature because this relationship has been indicated as essential for the sustainability of individuals, society, and the environment and for improving human wellbeing (Martin & McCullagh, 2011). It is evident that the main focus remains on how natural resources can be taught more effectively in the school environment, particularly in physical education (Simonek, Dobay,&Banhidi, 2018).For these aims, OE lessons are often based on the use of recreation activities. Therefore, it is clear how OE and PE need to be considered as complementary disciplines because both aiming to improve human wellbeing, but they used different paradigms and approaches. In this respect, PE should look to the "outdoor" as a strategy thatcan be involved in PE lessons because several previous studies affirmed the benefits of the physical activity performed in an outdoor context.For instance, it has been recently shown that PA in a natural setting (green exercise) creates wider positive effects on affective responses than indoor PA (Niedermeier,Einwanger, Hartl, &Kopp, 2017).Strong and colleagues (2005) affirmed that the risk of developing chronic illness can be drastically reduced by performing physical activity in an outdoor environment during childhood. Moreover, if a child participates in physical and sport activity such as hiking, camping, north walking, or orienteering will develop a positive attitude towards outdoor activities in a long-life perspective (Simonek et al., 2018; Wells &Lekies, 2006). Outdoor context permits to overcome indoor limits for playing sport disciplines for medium-to-large groups, such as the normal groups of a PE class (Sgrò, Barca, Schembri, &Lipoma, 2020a; Sgrò, Coppola, Tortella, &Lipoma, 2020b) and may has positive effects on motor-cognitive development (Tortella, Schembri, Ceciliani, &Fumagalli, 2020). Moreover, according to the

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recent National and the WHO guidelines to contrast COVID-19, outdoor is recently identified as a safe environment for performing physical and sports activities with a low risk ofgetting COVID-19.Last but not least, Hulteen and colleagues (2018) designed a model for describing the development of foundation movement skillsand they identified the relevant role of outdoor contexts for explaining as a child pass from the rudimentary to foundation movement skills step. For example, if a child lives in a city near to the sea, he/she will benefit fromthis outdoor context for improving several related skills and motor competencies better and faster than a child of the same age who lives in a city placed far away from the sea. In addition, educational activities that are developed *in, with,* and *through* outdoor environments have shown to promiseacademic achievement and these actives can be used to promote inter- and trans-disciplinary matter knowledge (Fin, Yan, & McInnis, 2015).In a framework of ecological dynamics, the skills acquired are linked to functional behaviors emerging in a specific environmental context (Seifert&Davids, 2017). Therefore, several reasons support the need to use outdoor context during PE teaching-learning processes. On the contrary, an issue with which several teachers are having to face is related to the choice of the path most adequate for supporting PE processes.Previous studies focused their aims on the assessment of outdoor paths for recreational, tourism, and sports activities (Wolf &Wohlfart, 2014; Di Felice, 2014; Chhetri, 2015). The indexes used in these studies are mainly related to the assessment of physical activity performed during the experience and, only in some cases, other perspectives such as emotional (i.e. the presence of animals) and motivational (i.e. the presence of a church or of an ancient stone) factors were considered. Then, all these methods were focused on typical aspects addressed in physical activity and sport studies (e.g., Fischetti, Cataldi, Di Terlizzi, &Greco, 2020; Fischetti, Latino, Cataldi, & Greco, 2020; Varde'I, Cejudo, Pilar, Raiola, & Izzo, 2020) but presented some limits about the chance to be used for assessing the suitability of a path in an educational perspective. Among these methods, the one proposed by Di Felice (2014) was based on a classification procedure that the current authors consider of interest for an extension towards its use within the educational perspective.Therefore, the aim of this study was to propose an assessment method based on the model proposed by Di Felice which can be used for supporting the teacher in the choice of the outdoor path adequate or suitable for their teaching and learning activities. An example of the application of this novelty mode for assessing the suitability of a path for outdoor-based physical education activities is also presented and discussed in this manuscript.

Di Felice's Method

Di Felice's method (Di Felice, 2014) stemmed from a widespread problem concerning the practice of hiking: the absence of a common protocol for the classification of outdoor routes that links the objective characteristics of these paths to the expectations of the participants. In particular, all existing evaluation/assessment methods mainly referred to the data acquired from geographic information systems (GIS) or to other physical characteristics of each route and path (Chhetri, 2015), while no elements are accounted for the other dimensions of human experience.

In light of the problems outlined, this study started from the conjecture that two independent and complementary factors are relevant in the domain of hiking: a) the human factor, which establishes the relationship between the physical characteristics of a path and the physical (e.g. age, height, weight, etc.) and training characteristics of a hiker; b) the motivational factor, as the relationship between several elements of a path (i.e. historical, naturalistic) and hiker motivation and satisfaction (DevesaLaguna, & Palacios, 2010).
Accordingly, the core of the proposal was the definition of a new approach for identifying route (*p*) suitable for a specific hiker (*h*) by mapping the two factors of the hiking domain into quantitative parameters. In this perspective, the following logical and mathematical reasons were proposed. Researchers call stretch each portion of the path (*p*) bounded by a variation of the slope. They use the parameter exertion (E), expressed in kilometers, to quantify the human exertion required to complete a generic path (*p*) according to the following formula:

$$E_p = \sum_{i=1}^{n} \frac{L_i + D_i}{L_i} \quad (1)$$

where *n* identifies the number of stretches in the path *p*, L was the length of a generic stretch in the path and D was the altitude variation between the start and the end of each stretch. All the parameters were expressed in kilometers and, if D was less than 0, the ratio D/L was set to 0.

As for the hiker space, the human dimension is quantified by the maximum sustainable effort of the hiker (E_h), expressed in kilometers, by taking into account three functions (v_a, v_w, v_t) which respectively represent the age, BMI, and previous training experience of a hiker *h*, as described by the Equation 2:

$$E_h = (v_a \times v_w \times v_t) \times E_{nom} \quad (2)$$

For what concerns the functions v_a, v_w, v_t,they can result as a value between 0 and 1.0, while their meaning is:
-v_a establishes a correlation between the age of a hiker and the E_{nom}. The basic consideration is that humans reach the peak of their physical performance at a young age (25-35 years) which they slowly lose over the years;

-v_w takes into account the maximum effort that a hiker can face without his body being damaged. The extent of sustainable effort by a hiker is maximum for BMI values between 18.5 and 25 and decreases for higher or lower values. The basic consideration is that the maximum sustainable effort of overweight (or underweight) person should be less than that which can be tolerated by a person whose weight is normal.
-v_t establishes a relation between the training of the hiker and the E_{nom}, by taking into account the excursions he/she made in the 12 months preceding the day in which he/she seeks a new path. Much details about the mathematical formulas used for estimating v_a, v_w, $v_t$can be acquired by the original work. The parameter $E_{norm}$is the maximum exertion that a hiker can support during a day and it was set to 24 km.
The basic assumption of this model is that a hiker with a human factor set to HF (h) = E_h can face a path characterized by a human factor HF(p)= E_p, if the following condition is verified:

$$E_p \leq E_n \quad (3)$$

About the motivational dimension (MF), Di Felice identified it as the set of possible reasons (i.e. naturalistic, religious, historical) why a hiker might want to undertake an itinerary. The path *p* is of interest toa hiker *h* if it is verified the Equation 4:

$$MF(h) \subseteq MF(p) \quad (4)$$

Summarizing, a path *p* can be suitable for a hiker *h* whether the following conditions are satisfied:

$$\left(HF(p) \leq HF(h) \wedge MF(p) \supseteq MF(h)\right) \quad (5)$$

The previous conditions can be applied by taking into account all the possible itineraries that a hiker can choose.

Extension towardseducational perspective

As stated in the Introduction of this study, the Di Felice's model had some limits for our purpose to use such a model for supporting teachers in their choice of a path adequate for developing outdoor-based physical educational activities. In this respect, the following changes have been proposed:

1) Provide an *ongoing* tuning of the elements related to the "Human Factors" of a hikeraccording to a *rule-of-thumb* approach based on the characteristics of the potential stakeholders of this model.
2) Change "Motivational Factors" dimension with "Learning Factors".

For what concerns the tuning of the original function related to the human dimension (i.e. age, weight, and training conditioning), the tuning will be underpinned to the validation process of the model with a sample of potential stakeholders less extent than the ones proposed by Di Felice. Specifically, the age's function will be tuned by considering that the student's age ranged from six to 18 years old. In the same way, the value of the maximum nominal exertion has been set to the value of 7.5 km according to the usual educational timeand the hypothetical students' maximum performance. Specifically, we proposed to estimate this parameter by considering that an educational activity can be the length at the most six hours (with several breaks) and a child can cover a max of 1.5 km per hour.

Learning Factors (LF) represents the dimension used the most to customize the Di Felice's method for supporting educational activities. Accordingly, if we define the space t = $\{t_1, t_2, t_3, \ldots t_n\}$ as the all possible teachers who want to develop teaching-learning physical education process in the outdoor path, the LF identifies several instructional elements that teachers looking for to choose a path for their next outdoor-based teaching activity. Let:

- LF = $\{lf_1, lf_2, lf_3, \ldots lf_n\}$: be the set of possible reasons why a teacher might choose this path for her/him next lesson;
- LF(p) $\subseteq$ LF be the set of the learning factors available in a path p
- LF(t) $\subseteq$ LF be the set of learning factors why a teacher might choose the path p

Then, a path *p* is of interest for a teacher *t* if it is verified the follow: LF(t) $\subseteq$ LF (p).According to this change, the Equation 5 can be rewritten in the following way:

$$\left(HF(p) \leq HF(s) \wedge LF(p) \supseteq LF(t)\right) \quad (6)$$

The Equation 6 can be applied by taking into account all the possible itineraries (*p*) that a teacher (*t*) can choose for their students (*s*).

Choosing the elements that the LF has to include represents a real challenge for the authors of this study because is really complex to identify a set of elements able to cover all the protentional learning factors. The educational perspectives of the outdoor-based activities are very large since we proposed a structure organized in three groups: Physical Education, transversal, and trans-disciplinary learning factors, respectively. A non-exhaustive representation of the elements included in each of the forecited factors is showed in Figure n.1

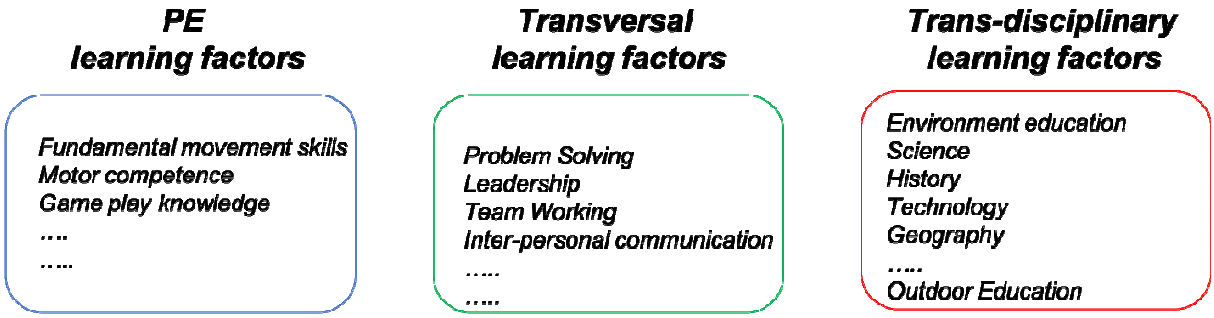

Figure 1. A preliminary indication of the learning factors suitable for an outdoor-based PE lesson.

The reader can easily identify the usage of the suspension points as the need to consider the identification of the learning factors for each group as ongoing activities. Specifically, the researchers of this study consider this choice as an activity related to several filters (i.e., socio-cultural, geographical), to the school classes learning aims,and to other elements strictly depended by the teaching approach.

Application of the proposed approach

To implement an outdoor-based educational activity it's essential to legitimize it. Take into account the learning outcomes is the first step. In this way, teachers can justify many outdoor activities to students, parents, and school leaders and consider them as formal teaching practices and not as simple outings (Kervinen, Uitto, &Juuti, 2020). In a primary school, a physical education teacher may decide to implement an outdoor learning pathway to stimulate the development of his/her student's fundamental movement skills (physical education learning factors) and to improve collaborative skills (transversal learning factors). Besides, in a transdisciplinary perspective, the teacher may decide to improve another academic purpose (i.e science) such as, for example, the alternation of seasons (trans-disciplinary factors). In this way, the teacher identified different learning goals linked to an outdoor-based activity. The second step is to detect an outdoor context consistent with them. Starting from the "affordances" theorized by Gibson (1979), that is potentialities of action activated by the single vision of an object, it is possible to understand how, in an urban context, a public garden offers children the opportunity to climb rocks and trees, walking and running on uneven terrain, throwing stones (pattern related to fundamental motor skills). However, according to the current teacher's choice, it's necessary that the path has a large area for cooperative activities and at least one element concerning the alternation of the seasons as a sundial.Figure 2 shows a real urban route of a Sicilian town with all the features of the proposed teaching-learning activity and the physical characteristics of the path.

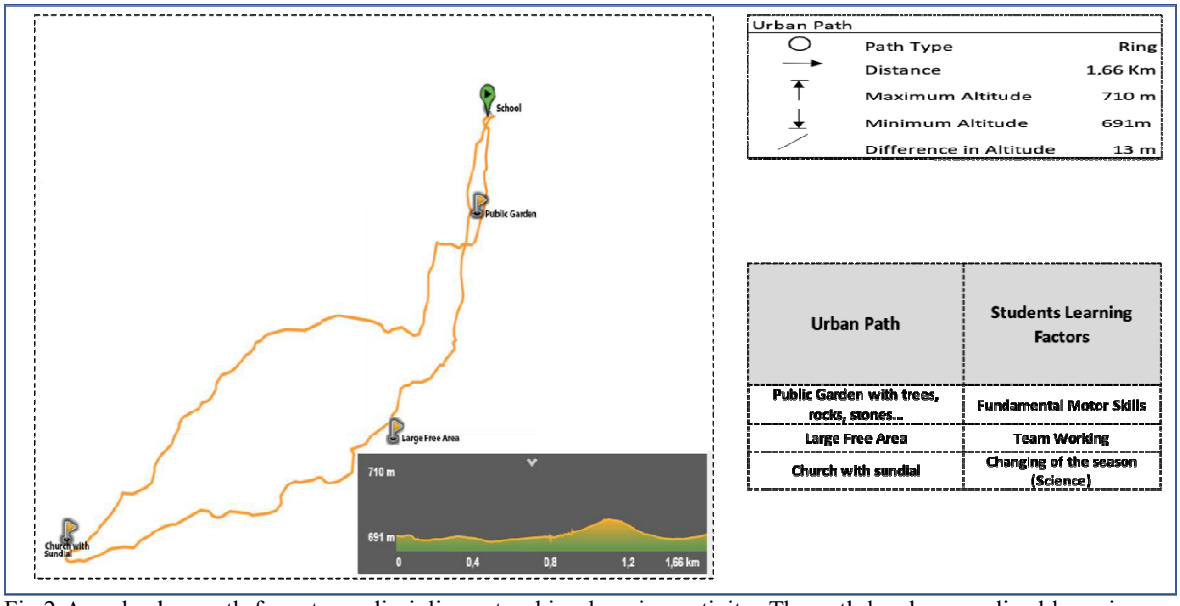

Fig.2 A real urban path for a trans-disciplinary teaching-learning activity. The path has been realized by using the website wikilock.com

Lastly, the teacher will have to ensure that the route chosen is safe and consistent with the physical characteristics of his students. In this respect, the length of the path to reach the church from the school and to come back is really short (about 1.7 km) and the slopedifferences very low (i.e. 13 meters). Because the activity

is organized for children of the third grade with low-to-moderate levels of physical activity, we can consider satisfied the Equation 3 and, therefore, verified the Equation 6.

Discussion

The aim of this study was to propose an assessment method that supports teachers to choose a specific outdoor path in accordance with the potential of individuals, with the environmental characteristics, and with the pre-established academic outcomes. The proposed model: a) recognizes the synergistic and reciprocal role of bio-physical and educational factors of the natural environment that influence motor development, b) supports the need to choose an appropriate didactic approach to sustain the development of physical education lessons in an outdoor context; c) supports the development of trans-disciplinary teaching-learning processes. In the last decades, many studies have discussed the obstacles that prevent teachers from using outdoor teaching (Scott, Boyd, Scott L. & Colquhoun, 2015; Lock, 2010; Glackin, 2018; Bentsen, Jensen, Mygind&Randrup, 2010), but few have provided practical support to solve these limits. Indeed, teachers know the potential of outdoor learning activities, but often feel hampered in facilitating and improving children's access to these types of activities (Van Dijk-Wesselius, Van den Berg, Maas &Hovinga, 2020) by transport-related factors, curricular requirements, and lack of time and resources (Rickinson et al., 2004; Edwards-Jones, Waite & Passy, 2018). On the contrary, because of digital technology, children spend more time in front of the screens and have gone away from the natural world (Ginsberg, 2007), while outdoor-based activities should be ideal to provide different and varied stimuli and, as the last goal, to support an overall development of a child.In addition, whether a child acquires the attitude to spend its free time outdoor, he/she should be much oriented to participate in structured sport activities. In this respect, the current study somewhat supports the strategies proposed by the World Health Organization (WHO) about the need to reinforce the children' behaviors towards the practice of outdoor-based games and sport activities during childhood and adolescence. As known, according to these strategies the levels of physical activities should reached the ones identified as necessary by the WHO guidelines to avoid illnesses related to sedentary behaviors (i.e., cardio-vascular) and to preserve an overall wellbeing during all the life.Anyway, to reach this aim is necessary that all the stakeholders (i.e. school, teacher, coaches, parents) somewhat related to the activities proposed to the children during this age work together with the purpose to establish a valuable synergy of action which lead children to go out from their virtual games and to choose challenging, fun, and outdoor-based physical and sport activities.

Conclusion

Although we understand the limits of the proposed approach and the need to assess the feasibility of this model throughout an empirical phase, we believe that our proposal can support teachers in the selection of paths and/or outdoor sites adequate for promoting teaching and learning processes of outdoor movement education.Indeed, as educators, we need to keep in mind the primary purpose of outdoor education, which is to provide meaningful contextual experiences, which complement and expand classroom education, which tends to be dominated by print and electronic media (Simonek et al., 2018).Under this influence, we cannot fail to consider the excellent results obtained by previous study, who stated that the activities carried out outside the classroom positively influence the improvement of gross motor skills (Valentini&Bartolucci, 2019).Finally, from a holistic perspective, the literature on outdoor educational environments makes us awarethat little is known about the potential increase in the development of cooperative skills when children enjoy playing outdoors (Duque, Fernando & Clemente2016).Given the above reflections, we are confident in asserting that the potential of outdoor physical activity, despite being extensively discussed, still has aspects that scientific research should develop.

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