Journal of Physical Education and Sport ® (JPES),Vol 21 (Supplement issue 1), Art 86 pp 702 – 708, Feb.2021
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Possible use of technological tools in outdoor movement education

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Published online: February 28, 2021
(Accepted for publication February 22, 2021)
DOI:10.7752/jpes.2021.s1086

Abstract
Technological development has caused an increase in hours children and adolescents spent in front of a screen (i.e. PC, console, smartphone, etc.) in the last decades. However, technology is not always responsible for a decrease in physical movement, in fact certain applications and/or games require active physical participation (i.e. exergames, virtual reality, augmented reality).The aim of the study is to bring out the potential of the use of technologies in Outdoor Movement Education. A bibliographic research was carried outto see which technologies had been used, how they had been used and the results obtained. The conducted research included the inquiry of three databases and a combination of several keywords. The results were organized according to the type of technology used.The results showed that the possible uses of technological tools in Outdoor Movement Education are remarkable. Especially, technologies that do not require special or expensive devices are not only quite usable, but alsoavailable to everyone. The results show how the use of technology is not only limited to the activity itself but the use of technologyenables more accurate data which would be closer to reality both while at school (i.e. formal environment) and after school (i.e. informal and non-formal environments). As can be seen from provided scientific evidence, aspects such as team work, motivation and involvement of children are also not to be ignored. These technologies can further be by people with disabilities providing them with greater interaction with the environment and to overcome difficulties inherent in a specific pathology.
Keywords: Outdoor Education, Outdoor Movement Education, technology, augmented reality, children.

Introduction

The term Outdoor Education (OE), at the international level, refers to a vast area of educational practices whose common denominator is the enhancement of the external environment in its various configurations, taken as an educational environment. The pedagogical orientation of OE does not define or prescribe which activities or educational paths must be implemented, or which objectives must be achieved, all of this relates to the specificity of the educational context and choices made by teachers and educators. OE places the emphasis on the pedagogical orientation related to making the most of the opportunities while being outside (outdoors) and of conceiving the external environment as a place of training (Farné & Agostini, 2014). The link with nature is important both on the educational level and on the one of the quality of life, not only to make children grow up well and healthy, but also to empower them and encourage them to protect our planet once they become adult citizens.Practicing physical activity and sports or the movement in general, has effects on body image (Fischetti, Latino, Cataldi, & Greco, 2020) and considering the fundamental role of the coach-educator it has a significant impact also on motor-cognitive development in early childhood education (Tortella, Schembri, Ceciliani, & Fumagalli, 2020). The OE effectiveness is highlighted by significant changes in physical condition, reducing the risk of developing cardiovascular diseases, increasing motor activity, and improving the psycho-emotional state (Apaychev, Zakharina, Hrybovska, Pityn & Hrybovskyy, 2018).

Research has shown that free play and OE have a positive impact on children, particularly on the development of social skills (Duque, Martins, & Clemente, 2016). Furthermore, OE positively influenced the results of preschool children at the motor level, resulting in an improvement in gross motor skills (Valentini & Bartolucci, 2019). In the last fifty years our lifestyles have changed significantly; a new perception of dangers and the spread of new technologies have progressively distanced man from nature and made the necessary contact with the natural environment more difficult(Schenetti, Salvatera,& Rossini, 2015). In the past, it was taken for granted that there was an immediate, direct and experiential relationship between children and nature: children have always loved running, playing outdoors and discovering the natural environmentwhich has a very important role in the development of physical fitness (Fischetti, Cataldi, Di Terlizzi, & Greco, 2020), but also improved mental representation of the space (Notarnicola et al., 2012). Instead, today, families find fewer and

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fewer opportunities, times and ways to experience nature directly. In particular, this happens in those families who live in large cities. Adults are discouraged by the lack of free time and by the pressing pace of work, by the alleged dangers hidden in the natural environment and by the means of mass communication that offer comfortable and captivating entertainment that frightfully bewitches children. The result is a generation of digital natives who perfectly master the world of technology, but who then find themselves disoriented in the natural environment, which is part of the physical and real world in which we live.

According to recent studies, the new generations spend more and more time in front of a screen. Frequently, time spent playing games on consoles or on social media reduces time spent in free outdoor activities in green areas such as lawns, gardens, or parks. Bertolino and Perazzone (2012) define this new generation of citizens who are growing up in an overprotected way as *spoiled children*. The increase in *indoor life* brings attention to children's movement totally in the background. Overprotective parents do anything rather than take their children to play outdoors using different excuses such as lack of suitable materials or equipment, lack of safety, fear of injury etc. (Tortella & Fumagalli,2014).

The University of Washington study highlights that over 60% of 5-year-olds spend more than four hours in front of a screen (Rosen et al., 2014). Time spent in front of a screen often has a negative impact on health. Several studies show a positive correlation between increased screen hours and obesity in both children and adolescents (de Jong et al., 2013; Arora et al., 2012). There are also numerous studiesindicating the hours spent in front of a screen as a variable predicting the decrease in physical activity (Anderson, Economos, & Must, 2008; Tandon et al., 2012; Schembri, Quinto, Aiello, Pignato, & Sgrò, 2019).But not all technologies cause a decrease in movement, in fact some devices require active participation of users.

Physical education has now become a permeable environment for the inclusion of technological devices, although there is some resistance to their integration into classrooms (Lizandra, Valverde & García-Massó. (2020). Different experiences conducted in the educational environment of physical education (PE) have demonstrated a plausible symbiotic relationship between Technological Means (MT) and Physical Activity (PA) (Castro, Gómez-García, 2016). For instance, the use of Information and Communication Technologies (ICTs) have proven to be relevant in the educational field, especially when their use adds value to the pedagogical process (Loia & Orciuoli, 2019).In this sense, exergames are a type of a video game in which interactionbetween the player and the game is not limited to the use of a manual controller(i.e. keyboard or joystick), but is related to body movement (Sgrò& Lipoma, 2015).

Exergames have been defined as a technologywith a high educational potential, as they can be integrated into teaching and learning contextswith the theoretical framework of learning(Rovegno, 2006) and compatible, to a large extent, with the objectives of physical education programs (Ennis, 2013; Giblin, Collins, & Button,2014; Sgrò& Lipoma, 2015).It remains clear, therefore, that the way in which natural resources can be taught more effectively in schools, particularly in physical education, plays a fundamental role (Simonek, Dobay & Banhidi, 2018).

Method

This study had a fundamental objective, to describe and bring out the potential of the use of technologies in outdoor movement education, and then to evaluate the possibility of using mobile devices for the integration of physical education content.

Search Strategy

In order to achieve the mentioned, a bibliographic research of three databases was carried out, including Google Scholar, OCLC WorldCat, and EBSCO Publishing. The keywords used in the search engines were from the title and abstract. These included *children*, *technology*, *movement*, *outdooreducation*, *augmentedreality*, and *QRcodes*. Combination of keywords was also used for the optimization of results. Our search terms combined OE keywords (*outdoor education*, *adventureeducation*, *wildernesseducation*), PE keywords (*physicaleducation*,*movement*), technology keywords (*VirtualReality*, *QRcode*, *augmentedreality*) and outcome keywords (*goals*, *benefits*, *outcomes*, *positiveimpact*).

Inclusion Criteria

In addition, the search filters used were the year of publication of an article from 2010 to 2020 and the availability of the full-size paper. The research results refer to the augmented reality, virtual reality and to certain sensors that can be used both in curricular, extracurricular and sports environment as this technology allows to obtain valid and reliable data and measurements. In fact, the next paragraph provides a critical reflection regarding possible uses of wearable sensors.

Data Extraction and Critical Appraisal

Two reviewers independently extracted data from each study and summarized them on a standardized form. This included general information (i.e. year of publication, research objective), study characteristics (i.e. environment, design), sample characteristics (i.e. age, gender), program characteristics (i.e. type of the program, activity) and results. Only the studies that clearly expressed the purpose, methods of data collection, description of the results, scientific rigor and interpretation of the results were analyzed.

Results

Augmented reality

Augmented reality technology has developed significantly in recent years. Increasingly present applications take advantage of this technology asking for greater involvement and providing more clarity in user information. It is often associated with QR codes, which even being an older technology (1994) in the last decade has had an impressive expansion both in the field of web-marketing and in the implementation of information in parks or outdoors in general. Experts studying augmented reality showed how the use of smartphones or tablets allows the development of self-learning and involvement skills during educational activities (Giannakas, Kambourakis, Papasalouros, & Gritzalis, 2018; Kamarainen et al., 2013). Some examples can be traced back to the use of smartphones in outdoor environments for the study of various animal and plant species as after being framed, the user receives information about it (Pombo & Marques, 2018). Another study underlines how interaction and information become more productive through the use of augmented reality as we move from instructions given by a teacher/instructor to a number *n* of participants in a one-to-one relationship in which each participant receives information directly (Folkestad & O'shea, 2011)and this has even more marked repercussions when outdoor activities involve movement with subsequent "dispersion" of participants. This has greater relevance when Outdoor Education activities involve very large groups where individual differences in reference to different attention, understanding skills or psychomotor skills become even more incisive. Aspects related to motivation are also increased as shown by various scientific researches (Balog & Pribeanu, 2010; Dunleavy & Dede, 2014).

A work by Laine and colleagues shows a platform for studying through augmented reality games called Science Spots AR. These Science Spots can also be implemented in an outdoor environment as they provide for the interaction between real and virtual objects and have an effect on both attention and commitment, and also allow a greater development of intrinsic motivation both in learning (Laine, Nygren, Dirin, & Suk, 2016) and movement.Since outdoor environments are not always controlled, the study analyzed how a combination of multiple sensors is required in an outdoor AR system to complete the registration process such as a GPS receiverfor positions and distances, inertial sensors and magnetic sensors for orientations (Lee, Suh, & Park, 2015; Rao, Qiao, Ren, Wang, & Du, 2017).The use of QR codes is mainly associated with devices such as tablets and smartphones that allow an intuitive and portable interface on the user. For years, augmented reality, also associated with playful activities or games that require active participation (movement of the participants), seemed out of reach, but recent entertainment hits like Pokémon Go have brought augmented reality into the mainstream.Several studies showed how the use of applications that exploit QR codes, in the purely educational and psychomotor fields, increase the effectiveness of teaching (Elliot, 2009), enhance learning outcomes (Richey, 2018), provide the possibility of creating adapted and personalized feedback based on the user (Quinn, 2000) and the creation of real “journeys” where digital tools are associated with paper and analogue tools (Lai, Chang, Wen-Shiane, Fan, & Wu, 2013).The advantages are also present when physical education is associated with outdoor education activities, and in this sense, we speak of outdoor movement education in reference to those outdoor activities that put the movement in the main focus. The complementarity between physical activities and outdoor activities was investigated in a study by Martin and McCullagh (2011) which also showed the relationship between the risk of practicing outdoor activities and its positive results. Finally, in a work by Hovey, Niland and Foley (2020) the positive impact of outdoor education activities on the self-efficacy of physical education students (i.e. PETE students) was analyzed. In fact, it is essential that outdoor movement education activities, especially in the educational-school environment, are conducted by professionals not only of movement, but also of outdoor activities as the variables to be taken into consideration are many more than those for an indoor environment.

Virtual reality

The term ‘virtual reality’ refers to a technology that involves the user in a virtual world through a viewer associated with other tools (i.e. joypad, cybertuta, earphones, wired gloves, etc.) that offer an experience on multiple sensory channels. In the scientific literature there are studies that use this technology mainly to compensate for difficulties of people with disabilities (Vasconcelos, Júnior, Malaquias, Miranda, & Santos, 2017). Virtual reality allows a person to develop a great interest especially in children and adolescents by requiring a great involvement and if used as a support tool it helps in the literacy process. Virtual reality, although not fully usable in an outdoor context, offers the possibility of movement and active participation, especially when subjects have temporary difficulties (i.e. injury, trauma) or persistence (i.e. disabilities, use of supports to move). Being a more invasive technology, to our knowledge, there are still no works that use these supports for outdoor movement education activities. The research results show different uses, especially for children with visual (Parton, 2017) and intellectual (Vasconcelos et al., 2017) disabilities.

Sensors and wearable tools

Among the most cited tools, especially in the field of evaluating outdoor activities, there are all those technologies that take advantage of the global positioning system (GPS) which is defined as a satellite-based technology precising location at any point on the surface of Earth, based on the position of satellites in the sky

(Klinker, Schipperijn, Kerr, Ersbøll, & Troelsen, 2014). Among the most used, especially in the last decade, are smartphones, smart watches, smart rings, heart rate monitors and magneto-inertial sensors (IMU). These tools measure heart rate, the activity carried out both indoors and outdoors and provide useful information for those who are physicallyactive or do sports. Their potential is especially useful in physical activities such as hiking or orienteering (Boström, 2011; Larsson, & Henriksson-Larsén, 2001; Norouzi, 2013). In the scientific literature there are many works where they are used for the evaluation of both physical and sports activities in the school environment (Coppola, Schembri, Pignato, & Lipoma, 2020; Sgrò, Coppola, Pignato, & Lipoma, 2018; Sgrò, Lo Bello, Lipoma, 2009;) and extracurricular activities (Jennings, Cormack, Coutts, Boyd, & Aughey, 2010; Sgrò, Quinto, Pignato, & Lipoma, 2016; Sgrò, Quinto, Platania, & Lipoma, 2019; Wheeler, Cooper, Page, & Jago,2010).This technology has been part of everyone's lives for several years, but not everyone exploits its great potential. Furthermore, for outdoor activities these technologies (especially GPS) have an even more marked value and precision. The use of GPS can be associated, in orienteering, with the use of metabolic measurement (Larsson & Henriksson-Larsén, 2001), not only during competitions where it can represent an evaluation and self-evaluation tool (Norouzi, 2013), but also during training sessions (Cych, 2006).

Discussion

Results of this research indicate that, although it cannot be defined as a systematic review of the literature, it is already possible to analyze many uses of technology in outdoor movement education. First of all, the focus should be placed on an element, in authors' opinion, essential to discuss the results or the change of the new generations of children and adolescents. In fact, the latter live in an increasingly digital world, where outdoor experiences are present in very limited quantities and depend both on the family context (i.e. fear of parents and "risk"), and on the social one (i.e. absence of a group of peers to play with) and the environmental one (i.e. presence of parks and green areas). But even if considering an ideal environment for outdoor movement education, children create bonds and share experiences in a different way from previous generations. The use of technology in formal and informal educational environments can in fact represent numerous possibilities not only for a result in terms of learning (psychomotor and cognitive skills), but also for the development of motivation in children.

However, technology must not replace social relationships or even activities in nature, but it can be a support that helps and adapts to different needs of teachers, instructors, pupils and children. Indeed, by definition it is impossible to replace outdoor experiences with indoor ones. "*Outdoor activities have many advantages such as the possibility of living an experience immersed in nature, greater involvement in teaching-learning activities, but also being able to develop the ability to be amazed and the thrill of discovery, managing to build a critical capacity by asking questions. about the environment or what surrounds them in general"*(Greene, 1968).Outdoor activities allow to relate not only to each other, but also to nature, in fact there is a lot of scientific evidence that shows how outdoor activity has a positive influence on children's health, and this technology can be a useful tool for measurements even in this respect (Klinker, Schipperijn, Kerr, Ersbøll, & Troelsen, 2014).

A central and fundamental element to keep in mind when talking about education in general, but without a doubt also with regards to outdoor movement education activities, is curiosity.Curiosity is the most important key to starting and continuing learning,and it is the heart of research. Doing research gives students the opportunity to understand and learn about their world(Tatar& Bağrıyanık,2012). Curiosity is also connected to one's own experience of movement and, in smaller subjects, to develop one's body image.Outdoor moving activities bring countless benefits both in terms of physical health (i.e. production of endorphins, respiratory, cardiac and muscular benefits) and mental health (i.e. reduction of stress, depression and anxiety).

Considering the emergency period in which people find themselves, more attention is given to the importance of movement and peoplestart talking about outdoor movement education again. In the educational environment, various contributions show how the benefits both at an educational and social level of "scuole in movimento" are clear (Tortella & Fumagalli, 2019; Tortella, Fumagalli, Coppola, Schembri, & Pignato, 2019), but in Italy, consideringthe primary school, the figure of the teacher specialized in motor and sport sciences is not yet foreseen (Sgrò et al., 2016) and this indicates how far behind Italy is compared to other European countries.

The new generations spend more and more time in controlled environments and in front of a screen, without practicing any kind of physical activity or movement in general, both for personal reasons (i.e. motivation, interest) and for reasons connected to the family (i.e. risk factor in the practice of activities in an external unprotected environment). Technology in this sense can represent a possible solution to involve and attract children more, and make them interested in outdoor movement education activities. Furthermore, the playful component present in some of these technologies increases the aspects related to motivation and allows the creation of an ideal "multidisciplinary didactic environment". Although Hwang and Wu (2014) point out how many studies have demonstrated the benefits of learning with digital tools (Yeh et al., 2010), educators haveemphasized the necessity of 'authentic learning activities' in which students can workwith problems from the real world (Tsai & Hwang, 2013).

Conclusion

It has been notedthatthe scientific literature already providescountless uses of technology in Outdoor Education. These uses increase especially when it comes to devices within everyone's reach such as smartphones or smartwatches. Being a physical activity, Outdoor Movement Education allows children to experience the surrounding environment by creating relationships with it, as well as offering the opportunity to work with other peers and develop social skills. Technology in this sense can help and support such activities especially when groups are large and personal differences become more marked. The benefits of using devices such as GPS or augmented reality allow a person to acquire more information and always have at hand data related to their outdoor movement activities. The possibilities arising from the use of technology in the field of evaluation and measurement should not be underestimated. Technologies make it possible to obtain more accurate datawhich would be closer to reality both whileat school and after school. Finally, the scientific evidence shows how not only technology leads to educational advantages, but also the way it affects other non-negligible elements and skills such as team work, motivation and active participation of pupils/children, and aspects related to inclusion of children with disabilities.

Author contributions

R.C.: Conceptualization, Methodology, Writing-Review & Editing, and Supervision.
R.S.: Conceptualization, Literature Analysis, Writing-Original Draft Preparation.
G.M.: Conceptualization, Writing-Original Draft Preparation.
F.S.: Conceptualization, Literature Analysis, Writing-Review & Editing.
All authors have read and agreed to the published version of the manuscript.

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