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Reducing fear of water and aquaphobia through 360 degree video use?

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Drowning is a serious public health problem threat claiming the lives of 372,000 people each year worldwide that can be linked to an individual's ability to swim. Learning to swim requires limited fear of water. This exploratory study investigated the potential interests of 360° video use for reducing fear and apprehension that underpin aquaphobia. Two students aged 11–12 years old who were non-swimmers with a reluctance to enter the water (i.e., a refusal and/or fear of immersion or to immerse only part of the face or the body in water) participated in qualitative interviews while viewing 360° video of an aquatic environment at progressively deeper levels through a head-mounted display (HMD). Three main findings were identified. First, the use of a 360° video viewed in an HMD led students to live an original corporeal immersive experience, a kind of immersion in the pool but experienced outside the pool. Second, students felt a strong emotional engagement between anxiety and curiosity from exploring the aquatic environment. Third, during the viewing situation, students developed and acquired accurate perceptive cues and knowledge related to the aquatic environment. The implications of these findings highlight the benefits of 360° video use as a tool to enhance greater confidence and familiarity with the aquatic environment to support learning and reduce phobia in non-swimmers. Limitations of the study and future research directions are discussed.

KEYWORDS

360° video, immersive experience, learn to swim, aquaphobia, fear of water

Introduction

Drowning is a major public health problem (Tyler et al., 2017; Thom et al., 2021) and according to the World Health Organization (2014), drowning is a serious and neglected public health threat claiming the lives of 372,000 people each year worldwide. During their annual general conference in Paris in 2015, the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2015) revised their "International Charter of Physical Education (PE), Physical Activity and Sport" declaring that the ability to swim is a fundamental right for all. The Charter specified that "the ability to swim is a vital skill for every person" (Point 2.2, p. 3). Furthermore, according to Hsieh et al. (2018), France ranks 11th out of 32 countries in the Organization for Economic Co-operation and Development (OECD) for the number of unintentional drownings. Therefore, learning to swim constitutes a fundamental ability for many educational ministries all over the world.

Learning to swim requires limited fear of water (Misimi et al., 2020; Peden and Franklin, 2020), considering that "fear of water can produce phobic behaviors counterproductive to the learning process" (Peden and Franklin, 2020, p. 1). For many people this might not be a problem; however, for people who suffer from aquaphobia, this specific kind of phobia can constitute an important challenge in learning to swim. The Cambridge Dictionary defined Aquaphobia (2022) as "a strong and unreasonable fear of water or of drowning" and is considered to be a "specific phobia" (Mehta and Espinel, 2021), which means "a marked and persistent fear that is cued by circumscribed clearly discernible objects or situations" (American Psychiatric Association, 2000, p. 219). Furthermore, Palazzolo (2014) underlines that "aquaphobia is a persistent and abnormal fear of water. It is a specific phobia that involves a level of fear that is beyond the patient's control or that may interfere with daily life" (p. 1). Some of the more common symptoms of aquaphobia include anxiety, unreasonable fear when exposed to water, avoidance of water, rapid heartbeat, nausea, and dizziness or fainting (Bakar and Bakar, 2017). Therefore, fear of water and/or aquaphobia can lead to difficulties in learning to swim or drowning but also can have negative lifestyle consequences (Love et al., 1990) due to persistence of fear of water from childhood through to adulthood (Peden and Franklin, 2020).

One way for treating such a phobia can be to use virtual reality (VR) tools, for example, which have already been used to reduce arachnophobia, agoraphobia, or acrophobia (Botella et al., 2017). VR is also used for aquaphobia treatment, however to our knowledge, this field is actually not been explored in depth. Tembekar et al. (2019) underlined that VR has the ability to render environments where an aquaphobic individual can experience a fearful situation visually, without any physical danger. These authors used VR to reduce aquaphobia that was assessed by a pulse-rate sensor. They identified a decrease in the heart rate of participants when viewing VR situations.

During the last 10 years, 360° video use has been developed and gained popularity (Roche et al., 2021) and differs from VR. Indeed, VR is computer-generated, three-dimensional, and interactive (Bryson, 1996); however, 360° video does not offer this possibility to interact although it provides an opportunity for more realistic simulation situations and greater learning and engagement in the simulation situations (Dubiago et al., 2018). For this reason, 360° video can offer an interesting way for reducing aquaphobia. Shadiev et al. (2021) underscore that 360° video use can reduce stress about real situations in which participants are "going to act."

360° video uses in sports and physical education field

Video in the field of sports performance and training has a long history of use with, for example, the seminal work on chronophotography developed by Marey and Demeny (1893) and Rossell (2013). While the use of video seems to be well established in the field of sport (e.g., Wilson, 2008; Fadde and Zaichkowsky, 2018; Kok et al., 2020; Lee and Chang, 2021), the use of 360° video still seems to be in its infancy and early experiments in a developing field of research (Araiza-Alba et al., 2021). Paraskevaidis and Fokides (2020) suggested that the potential of 360° video is still largely unexplored in the research and training fields.

Moreover, 360° video must be clearly differentiated from VR. Indeed, Snelson and Hsu (2019) underlined that in the literature there is some blurring in the use of the terms 360° video and VR. A total of 360° video is defined as "a panoramic video filmed with an omnidirectional camera that allows the viewer to have an uninterrupted vision of the scenes in an uninterrupted circle rather than the fixed viewpoint of traditional two-dimensional (2D) videos" (Araiza-Alba et al., 2021, p. 2). VR is based on three main dimensions (Bryson, 1996): (1) VR is computer-generated (not based on the real image), (2) VR is three-dimensional, and (3) VR is interactive, for example, offers the possibility to move objects. If the lack of interactivity of 360° video is pointed out by Torres et al. (2020), this kind of video can offer the possibility of orienting oneself in the space of the viewed situation and thus perceive certain angles of view and observe only certain specific aspects of a situation (Roche et al., 2021).

In recent years, the use of 360° video has also developed in the field of sports training for multiple purposes: To improve decision-making skills (Panchuk et al., 2018), learn climbing safety procedures (Gänsluckner et al., 2017), increase motivation during practice on fitness devices, such as bicycles or rowing ergometers (Hebbel-Seeger, 2017), and learn motor skills (Paraskevaidis and Fokides, 2020). A total of 360° videos offer the possibility to "improve the fidelity of training by presenting a realistic, 360° view of the competitive

environment" (Panchuk et al., 2018, p. 1). This strength is similarly noted by Paraskevaidis and Fokides (2020) about the realism of the environment users are immersed in through 360° video. The high fidelity of real competition situations offered by 360° video also allows a high degree of engagement with what the trainees see. Furthermore, 360° videos constitute a new tool for creating more realistic and interactive perceptual-cognitive training environments and a perceptual training tool (Panchuk et al., 2018) because of the first-person perspective it provides (Paraskevaidis and Fokides, 2020; Musculus et al., 2021). Panchuk et al. (2018) improved decision-making skills in basketball players following an immersive video test with HMD in which video is played back on the mobile phone of the athlete. In another study with basketball players, Pagé et al. (2019) found as little as four training sessions during which the players observed video clips of basketball plays presented either on a computer screen or using an HMD had demonstrated potential interest in 360° videos for improving decision-making skills.

If video feedback was used in PE class, this technology has been used to lesser degrees in technology-"unfriendly" environments beyond the gym, such as swimming pools (Kretschmann, 2017). This author showed an interest in the use of a tablet for providing video feedback to learn to swim with 5th-grade PE swimming classes. This study demonstrated that a teaching scenario based on video feedback allows for improvement in swimming performance. To our knowledge, there is actually no study based on the use of 360° video to learn to swim, and uses of this technology are actually unexplored in the field of learning to swim. Araiza-Alba et al. (2021) investigated the potential for using 360° video, as a tool to teach children about water-safety skills in comparison with other instructional mediums like traditional video, or posters that present procedures for water-safety. Findings reported participants engaged in the 360° video protocol had higher levels of interest and enjoyment than participants using the other two mediums (Araiza-Alba et al., 2021). A total of 360° videos are considered by Araiza-Alba et al. (2021) as a useful tool to teach targeted skills and a more motivating and engaging tool than using traditional learning methods. Furthermore, previous studies (e.g., Pimentel et al., 2021) have shown that 360° video is a powerful tool for developing empathy and also for feeling specific emotions due to the viewed situation (e.g., Gold and Windscheid, 2020).

Based on these previous findings, we want to study the effect of 360° video viewed with a Head-Mounted Display (HMD)[1] for smartphones to reduce fear of water and aquaphobia to learn to swim.

Research questions

The objective of this study was to evaluate 360° video uses to reduce aquaphobia among students in a secondary school setting. To address this objective, we posed two research questions:

> RQ #1: *What is the lived experience (i.e., emotion, perceptions, concerns, and type of knowledge used) by students when watching a 360° video of different underwater depths?*

> RQ #2: *How can 360° videos be used for reducing aquaphobia-based aspects of swimmers' lived experiences during viewing situations?*[2]

Theoretical lens

The study is situated in the theoretical lens of the Course of Action research approach (Theureau, 2010) used in cognitive anthropology and is part of the enaction paradigm and embodied cognition perspective. This lens aims to consider human activity according to a double logic of, activity as enaction (Varela et al., 1991) and experience (Poizat et al., 2016). The object of analysis of this program is the activity, accomplished in a real situation that is, in a given physical and social environment. One component of this program of research is the course-of-experience framework and it contributes to studying cognition in practice. The activity is always considered situated in reference to the theories of situated action (Suchman, 1987) and situated cognition (Hutchins, 1995). Consequently, it is always necessary to consider the particular context (human, material, spatial, temporal, etc.) in which the activity takes place to be able to access the level of the activity that Theureau and Jeffroy (1994) consider that the actor can show, tell and comment on. This level represents what is significant for the actor *in situ,* in the specific context in which he acts. The situation is therefore significantly constituted by the actor in the course of his actions, as he uses resources offered by the environment. In reference to the theory of enaction, Theureau (2010) considers the actor as autonomous (Varela, 1989). His actions have self-organizing properties because, in the dynamic of his activity, he elaborates on his situations and constructs their meaning. The experience that the actor makes of the situations that he lives in has a subjective dimension (although partly culturally shared), autonomous, and embodied. Although

1 Head-mounted displays (HMD) are projection technology integrated into mounted on a helmet.

2 Viewing situation is the situation during which students viewed 360° video filmed in the pool, under the water.

inscribed in a singular action-situation coupling, it also has a dimension of genericity, in the sense that it presents typical traits with other experiences. Interactions between actors and their environment are considered asymmetric in the sense that actors select only elements in the environment that are relevant for them at a given moment to their internal organization (Theureau, 2010). In this approach, activity is considered a course of experience composed of subjective concerns, perceptions, emotions, and knowledge permanently changing over time.

Materials and methods

Participants and procedure

For this exploratory study, we conducted a multiple case study (Stake, 2005) with two volunteer students (Alexandre and Clemence, first names have been changed to preserve anonymity) from a group of students aged 11–12 years during a PE lesson for learning to swim. By using these cases, the main goal was to design a pilot program based on students' experiences of struggling with a fear of water and aquaphobia.

All participants were non-swimmers and were extensively informed regarding the aims of the study before providing their written consent and their parents' written consent. We also obtained the authorization of the school principal and PE teacher for conducting this research. During the first lesson on swimming, these two students had a reluctance to enter the water (i.e., a refusal and/or fear of immersion, immersion only of a part of the face or the body). Alexandre and Clemence participated in the study because of their particular apprehensiveness of water and behaviors to avoid real immersion in the swimming pool. At the beginning of the second lesson, to make sure that the students were able to get used to the aquatic environment, they discovered the bottom of the pool in which they will swim. At the beginning of the lesson, students viewed (only one time to not limit their practice time) 360° videos taken in the swimming pool at different depths. They viewed progressively deeper and deeper 360° videos during viewing situations that were filmed in the swimming pool without pupils in the water. In our experimentation, we uploaded 360° video in a smartphone (for using a gyroscopic sensor) and this one is inserted into an HMD (**Figure 1**) to render and display the 360° video content.

Video viewed in HMD with smartphones (duration 4 min 55 s) presented video images to participants that were recorded at different depths and offered them the possibility to discover and see the aquatic environment in which they were going to swim (without swimmers present to help them to familiarize with underwater conditions without other information to take account) (**Figure 2**).

FIGURE 1
Head-mounted display for smartphone used for viewing 360° video.

Students watched the videos by the pool before immersing themselves in the water. To guarantee positive experiences for the students' mental health and not to create traumatic experiences, the students were instructed they could stop the viewing experience at any time if they were afraid or if this experience was too unpleasant for them. Furthermore, following the experience of viewing the 360° video and when they returned to the water in the pool, the two students were been accompanied by a dedicated teacher in case they felt intense panic fear.

Data collection

The study used qualitative methods through self-confrontation micro-phenomenological interviews (Poizat et al., 2022) with two students (interviews were made individually immediately after the 360° video experience). This occurred through gathering two categories of data: (1) the swimmer's verbalization during the interview to elicit their lived experience during the viewing situation and (2) a description of behavior during the viewing situation (e.g., body and arm movements).

During the viewing situation, the HMD screen was recorded with specific software and this film has been used for the self-confrontation interview that was realized at the end of the lesson (**Figure 3**).

The purpose of the interview was to report on students' experience during the 360° video viewing situation and also their cognitive activity. The self-confrontation interview is a method of documenting an individual's cognitive activity through the researcher's questions. For realizing this kind of interview, the actor (here the student) is confronted with records related to their activity (**Figure 4**), and invited to detail, demonstrate and comment on the most significant points of this activity (in the presence of another person, namely the researcher).

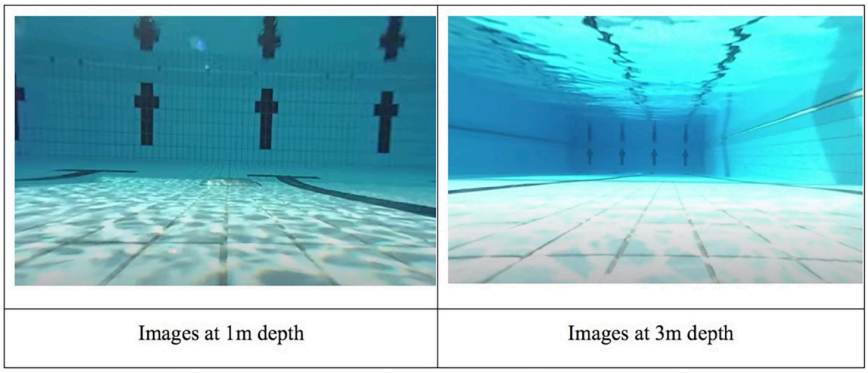

FIGURE 2
Videos from HMD for immersive viewing situations.

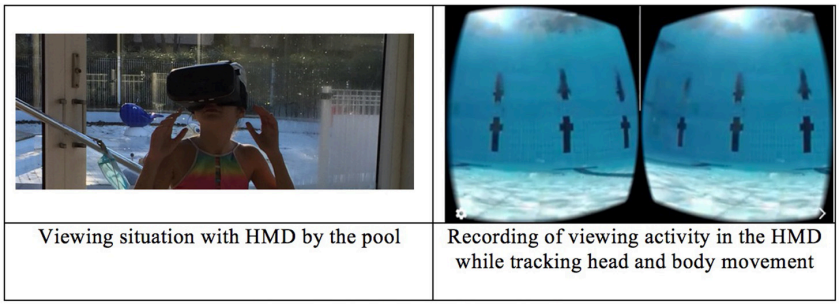

FIGURE 3
Method for data collection.

During the self-confrontation interview, the researcher asked the student to describe their concerns (e.g., What are you trying to do at that moment?), perceptions (e.g., What do you pay attention to? What do you notice?), emotions (e.g., What do you feel?), and what types of knowledge were used (e.g., What are you thinking about at that moment, what do you tell yourself?). For conducting qualitative research with adolescents, Eder and Fingerson (2002) recommend combining interviews with other methods "to capture fully the richness of human experience" (p. 40). In addition to the interview, a Likert scale was filled out by the students to rate their degree of apprehension when viewing the videos shot at different depths because young pupils can sometimes have difficulties explaining their feelings and emotions with accuracy.

Data analysis was realized in two stages: (1) A description of the student's activity from the ethnographic description; and (2) an analysis of his activity during the viewing situation. The description was built as presented in a protocol with four columns: (1) The time code of the viewing situation; (2) students' actions during the viewing situation; (3) students' verbalizations during the self-confrontation interview; and (4) content analysis. Self-confrontation interviews were analyzed in reference to the analytical course-of-experience framework inspired by Peirce's semeiotic (Skagestad, 2004). The course-of-experience framework is based on the notion of tetradic sign (Theureau, 2004). The tetradic sign is a triad that linked object–representamen–interpretant subjacent to the course of the experience unit. Poizat et al. (2022) defined the object like referred to the actor's involvement in the situation, the representamen refers to perceptive, proprioceptive, or mnemonic judgment, and the interpretant refers to the activated (or established) knowledge that allows the actor to interpret the situation (**Table 1**). The course of experience unit refers

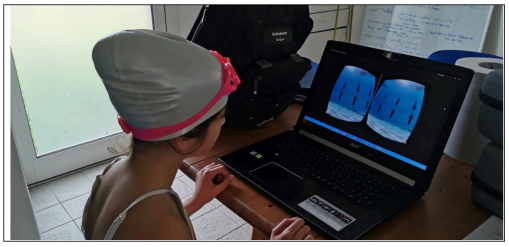

FIGURE 4
Self-confrontation with swimmer during lap-top viewing.

TABLE 1 Example of data analysis.

Time code of the viewing situation (with HMD)	Clemence's actions during the 360° video viewing	Clemence's verbalizations during the self-confrontation interview	Content analysis using semiotic triad
3′54: beginning of 360° video at 3 m deep	Clemence becomes more agitated than before watching the video at 3 m deep. She raises her arms and try to touch something with her hands. At the same time, she moves quickly to her left.	R: What are you doing at that moment when you raise your arms? C: I'm afraid because it's deep...I see the bottom of the pool...so I try to touch something solid...an edge...to be less afraid. R: What are you trying to watch? What are you observing? C: I want to see where I am in relation to the surface...there is less light so I know i am deep.	**Object:** Reassures herself by finding a solid part. **Representamen:** Feeling immersed deeply in the pool (lack of solid support, visual perception of the bottom of the pool, height of water associated with the loss of luminosity). **Interpretant:** Identifying the usual elements (top/bottom for surface/depth) to evaluate the depth from the intensity of the light.

R, researcher; C, Clemence.

to practical actions, communications, interpretations, emotions, feelings, and self-talk (Poizat et al., 2022).

All data from self-confrontation were coded by two researchers to identify each category of the tetradic sign. When a disagreement arose between the two researchers' coding, a third researcher was involved to assess discrepancies.

Findings

Three main results of the study can be underlined. First, the use of 360° video viewed in an HMD led students to live an original corporeal immersive experience, a kind of immersion in the pool but experienced outside the water. Second, students felt a strong emotional engagement between anxiety and curiosity from exploring the aquatic environment. Third, during the viewing situation, students developed and acquired accurate perceptive cues and knowledge related to the aquatic environment.

A viewing activity close to the real activity in the water

During the viewing situation with HMD, Alexandre and Clemence watched the video as if they were really immersed in the water. Indeed, they carried out a real visual exploratory activity, one that involved them actively engaged in the viewing activity, not only like a spectator but also physically. They are engaged as potential swimmers. What they perceived refers to solid elements that appear familiar, and reassuring for them (e.g., edges of the pool). These elements constitute potential resources for engaging in real in this destabilizing environment. Indeed, they turned their head, and looked up, down, and in all directions. This activity reflects a concern for safety, as they try to perceive where the edges of the pool are located or where they could grab hold if they were in trouble or about to drown. Moreover, by visually exploring the depth of the pool through the 360° video, they built their first perceptual cues in the depth of the pool. Thus, they built landmarks related to depth, and distances from the edges which allows them to project themselves in the way they could move underwater: "*It prepares me to go in the water, I feel more comfortable because I know where I will go, where I can go. Before I saw the video, I couldn't see where I could go in the water because I've never been underwater*" (verbalizations from Alexandre's self-confrontation interview). While watching the video, Alexandre looked at the bottom of the pool for a long time, turning his head left and right. He forgot that he was not really in the pool but only viewing a video. The viewing situation led him to live an immersive experience in the spatial aquatic environment in which he was going to swim. The viewed aquatic space was experienced as a space of effective body movement. Indeed, he was so "immersed" in the situation that he thought he could observe his feet in contact with the bottom of the pool to envision his movement in the water. During the viewing, the students developed a kind of virtual and fictional aquatic activity, a kind of "doing as in real" without being in the water.

Strong emotional engagement between anxiety and curiosity

During the poolside viewing situation of the 360° video with HMD, students were strongly emotionally engaged in the viewing situation. Indeed, data from the Likert scales showed higher ratings of emotional engagement as they watched deeper and deeper video footage. For Alexandre, his feelings of fear evolved from 1 (not afraid at all) to 3 (moderately afraid) as a consequence video from increased depth, whereas Clemence's feelings evolved from 3 (moderately afraid) to 5 (extremely afraid). Moreover, during the viewing, Alexandre exclaimed "*Wow, it's really deep!*" (verbalization during viewing with HMD), showing his surprise and his involvement in the viewing situation.

During the self-confrontation interview, Alexander states that he felt sensations of fear related to the aquatic immersion

and although it is fictional, he acknowledged feeling a certain anxiety that increased as the viewing progressed. He felt a sensation of fear and anxiety because he was virtually immersed in an uncertain environment, the aquatic environment which he did not know and which he apprehended. The anxiety felt by Alexandre during the viewing situation allowed him after the viewing, to feel less anxious to get into the water and to immerse himself in the water. He declared that he was less afraid, but even after viewing the 360° video with HMD, he still had a slight apprehension about the aquatic environment. Clemence appreciated being able to discover the aquatic environment in which she was going to immerse herself. Thus, she discovered that there was nothing dangerous about being underwater, particularly in an environment that she had never explored: "*Seeing underwater is less frightening, I can see the bottom, I can see that there is nothing dangerous!*" (verbalizations from self-confrontation interview). She remained reassured after the viewing, but this viewing experience was particularly intense emotionally for her. This was evidenced by her making many movements during the viewing, sometimes trying to grasp the edges or the lines of water that she saw in the video. The movements became more pronounced as she watched deeper and deeper videos.

Acquisition of accurate perceptive cues and knowledge related to the aquatic environment

Viewing 360° video at different depths allowed the students to visually perceive the depth without being in the water as when Alexandre was surprised by the depth. In addition, viewing 360° video with an HMD provided the opportunity to observe the pool from the bottom of the pool by looking up as the student was actually at the bottom of the water. The students developed visual knowledge about the pool environment by watching the video and discovering that the amount of lighting and the colors differ according to the depth: "*The deeper I go into the water, the darker the environment, I didn't know that*" (verbalizations from Alexandre' self-confrontation interview), "*When I am very deep, I see less light*" (verbalizations from Clemence' self-confrontation interview). Moreover, the sound of the video allowed them to hear in different ways the ambient noise which is less and less audible with the depth and more and more muffled. By viewing 360° video with HMD, students can acquire accurate perceptive cues and knowledge related to the aquatic environment to immerse themselves without apprehension or fear. Viewing 360° video leads them to become more "perceptually" familiar with the aquatic environment. The viewing experience that they live limits the effects of surprise and feelings of strangeness when they discover the depth of the pool. Indeed, by discovering the aquatic environment through a 360° video, the students live an experience that allows them to limit the number of unknown and destabilizing elements in the water, which could lead to creating conditions for a more serene body engagement in real immersion in the pool.

Discussion

Our findings showed that the use of 360° video viewed with an HMD for a smartphone provided students with a highly emotionally engaging experience of immersion in the aquatic environment. This can be seen to provide an important psycho-emotional effect in reducing the fear and apprehension that underpins aquaphobia in an actual aquatic environment. Based on the three findings, we found that by having a "testing ground" for experimenting with anxiety and curiosity in a safe, emotionally engaging immersive environment provided by 360° video, it is possible the acquisition of relevant knowledge and perceptual cues can help contribute to greater confidence and familiarity with the aquatic environment to support learning and reduce phobia. Our immersive environment constitutes a safe cognitive practice field for non-swimming people by offering them the possibility to escape the situation by removing the HMD if they feel a strong anxiety. While we did not explicitly test these relationships, our exploratory study found the use of HMD served many psycho-emotional benefits for swimming learners. Indeed, Botella et al. (2017) have shown that VR is a useful tool to improve exposure therapy for phobia treatment. Due to its low-cost and its high degree of realism, 360° video can constitute a powerful new tool for aquaphobia treatment. Shadiev et al. (2021) underscore that 360° video use can reduce stress about real situations. Based on our initial findings, we think gathering more quantitative data to confirm our findings would be helpful and transfer tests could be the next step in this research to understand influences on swimmers when in actual aquatic environments.

Interestingly, Alamäki et al. (2021) showed that the use of a low-cost HMD can decrease positive user experiences when they were watching 360° video. Our findings do not fit this perspective because the experience lived by the students is marked by a strong emotional impact and the students reported little difficulty in watching the videos. This can therefore be explained by the age difference of the participants to that of Alamäki et al. (2021) study which used adult participants. Furthermore, these authors showed that the 360° video experience was noted to be better without low-cost HMD. This perspective potentially allows us to consider the use of 360° video without HMD such as viewing on a tablet or sharing with students through a learning management system. Our findings demonstrated that even with HMD for smartphones, positive findings can also be obtained, which can easily lead to a replication of the use of this technology due to its low-cost. Worth consideration, Melo et al. (2016) showed that exposure times can influence spatial presence, which consistently increases with exposure time. These findings

lead us to reflect on the use of the different duration of 360° video to develop a more spatial presence and potentially accurate perceptive cues and knowledge related to the aquatic environment.

This study showed that students are engaged in the use of 360° video and this result is in line with Rupp et al. (2019) who demonstrate that 360° video uses are associated with an increased interest in learning and that highly immersive experiences using 360° videos provide positive educational experiences. One perspective for the future development of more positive experiences could be to use more immersive technology like VR headsets.

Virtual reality is used for the treatment of a lot of phobias like acrophobia (Emmelkamp et al., 2001) or agoraphobia (Botella et al., 2007) and numerous studies have shown a large interest in VR uses for reducing phobic symptoms (Botella et al., 2017) and to offer higher degrees of immersion. VR helps people to develop knowledge and perception due to specific situations. But the use of VR remains marginal due to its cost and the technical skills needed to produce this type of resource, 360° video seems more likely to develop in the treatment of mental disorders, phobias treatment, psychopathological symptoms, or even clinical interventions (Ionescu et al., 2021). For the authors, immersive 360° video successfully increases users' feelings of presence, given their realistic features, and therefore it can yield positive outcomes in clinical interventions (where presence is considered an essential precondition). This aspect is aligned with our findings concerning the activity developed by the students when they viewed the 360° video filmed in the pool. They behaved as if they were in the pool. This feeling of presence is helpful for struggling with fear of water. Other studies showed that 360° video use can reduce public speaking anxiety in children (Sülter et al., 2022) and panic disorder with agoraphobia (Lundin et al., 2022).

One limitation of our study pointed out by the literature about VR HMD is related to motion sickness-like sensations (Lawson, 2014), or vertigo (Johnson, 2018) leading to the abandonment of this technology. In our study (with a small sample), we did not identify such sickness feelings nor differences between gender like Grassini and Laumann (2020). To be able to envisage a precise use adapted to the characteristics of the students, it seems interesting to differentiate the use of 360° video with regard to levels of apprehension in the aquatic environment that could be identified with the Fear of Water Assessment Questionnaire (Misimi et al., 2020). It could be possible to envisage uses on tablets or with HMD according to the level of fear of water or aquaphobia.

A second limitation of our study is the number of participants. However, we chose to take a multiple case study approach initially which can provide foundations for conducting a mixed method study based on quantitative data (by questionnaires and measurement of salivary cortisol) including data from interviews to obtain a higher degree of generalization of the findings. Finally, another limit remains in the difficulties of collecting young children's verbalizations. Indeed, Eder and Fingerson (2002) recommend creating a natural and effectively secure context for realizing interviews. For students who are non-swimmers, being interviewed at the pool is not a natural environment, and can lead to certain problems in terms of verbalization of their feelings.

Conclusion

Learning to swim requires limited fear of water (Misimi et al., 2020; Peden and Franklin, 2020), and reducing fear of water and aquaphobia is one factor in preventing drowning. This concern goes beyond national concerns and also represents a worldwide priority. Our findings allow us to consider that our approach could be an innovative and potentially effective approach to reduce fear of water and aquaphobia and to promote learning to swim for all children (and also adults) to prevent drowning. Thus, the future work that we will undertake will aim at reporting on a larger scale the potential effects of the use of the 360° video to reduce fear of water and to show how highly emotional and engaging viewing experiences of 360° video (with or without HMD) can lead to a real engagement in the aquatic environment with a less intense affective impact and reduction of fears.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by EForTes laboratory, University Mohammed VI Polytechnic, Morocco. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

LR wrote the manuscript. IC, CR, RF, and SM all helped with the conceptual idea and editing. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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