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A 360° video as visual training support for independent movement acquisition—benefit evaluation with the TAM

Introduction

Conventional video technology is already widely used as a teaching–learning medium for educational processes (Noetel et al., 2021), which also has high training potential in sports as an established training tool thanks to the visual representation of complex dynamic movement sequences (Rekik, Khacharem, Belkhir, Bali, & Jarraya, 2018). Additionally, it is used, for example, as a video feedback (Mödinger, Woll, & Wagner, 2022; Potdevin et al., 2018) and analysis tool (Ruzicka & Milova, 2021) or to teach tactics (Koekoek, van der Kamp, Walinga, & van Hilvoorde, 2019) in sports.

Immersive technologies, such as virtual reality, which have a higher level of interaction with the medium and enable realistically perceived training experiences (Miah, Fenton, & Chadwick, 2020), offer further training potential (Fadde & Zaichkowsky, 2018; Le Noury, Polman, Maloney, & Gorman, 2022), for example, for reaction training in karate (Petri, Emmermacher, Masik, & Witte, 2019), as a training tool for techniques (Pastel et al., 2022), for tactics training (Pagé, Bernier, & Trempe, 2019), or for perceptual enhancement (Appelbaum & Erickson, 2016).

Videos that are 360°, as a link between conventional video technology and immersive technology, adopt the training potentials of conventional training videos, expand observation possibilities, and combine them with immersive training experiences. To date, however, 360° videos tend to be used exploratively as training tools, although they show high training potentials for improving attention and perception of, for example, game situations (Fadde & Zaichkowsky, 2019; Kittel, Larkin, Elsworthy, Lindsay, & Spittle, 2020b; Panchuk, Klusemann, & Hadlow, 2018) or tactics training (Pagé et al., 2019) in combination with high motivational effects (Bird, Karageorghis, Baker, & Brookes, 2019; Hebbel-Seeger, 2017). Apart from clear evidence from increased research on suitability as a training tool, there is still a lack of competencies for the use of digital media in sports applying methodological concepts (Vogt, Rehlinghaus, & Klein, 2019). For individual training content, for example, for predefined movement sequences and choreographies, such as poomsae forms in taekwondo or kata in karate, initial training steps have already been demonstrated using 360° video technology (Rosendahl, Klein, & Wagner, 2022; Rosendahl & Wagner, 2023b). An evidence-based evaluation of 360° videos as a useful training tool for learning movements is not yet possible due to the exploratory research situation, but the few studies available of 360° videos as a training tool indicate a positive training benefit (Kittel, Larkin, Cunningham, & Spittle, 2020a; Paraskevaidis & Fokides, 2020; Piccione, Collet, & de Foe, 2019; Rosendahl, Müller, & Wagner, 2023). In summary, the few SWOT (strengths, weaknesses, opportunities, and threats) analyses or systematic literature reviews show strengths, weaknesses, and potential applications of 360° video technology, such as multi-perspective panoramic images for action observation in addition to a positive evaluation of 360° video technology (Kittel et al., 2020a; Kittel, Spittle, Larkin, & Spittle, 2023; Lindsay, Spittle, & Spittle, 2023; Rosendahl & Wagner, 2022; Rosendahl & Wagner, 2023a).

In particular, this freely selectable multi-perspective viewing option in 360° videos expands the possibility of observation. Individual learning of movements by observing demonstrated movements involves an individually desired perspective of the observer on the movements themselves (Büning & Wirth, 2020). Thus, for some observers, the demonstrated movements directed toward themselves are more helpful, for other observers, the movements directed from the opposite perspective from behind, with the associated possibility of synchronous movement execution, are more advantageous (ibid.). Others also desire lateral representations. With conventional video technology, these individually selectable viewing options of movements are only associated with multiple camera settings and post-processing efforts. The 360° video technique allows for a free choice of viewing direction and thus a possible different perspective on the demonstrated movements without such an effort (Rosendahl et al., 2023)

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and without the use of virtual reality applications (Lindsay, Kittel, & Spittle, 2022).

The aim of this study was to compare 360° videos and conventional videos as visual training support, focusing especially on the individual multi-perspective viewing option in 360° videos. Our research intent relates to two issues: One is the usefulness of the video formats and the other is the subjective evaluation of the two video formats as visual learning supports. The benefits of 360° video technology's multi-perspective viewing option as a visual training support has already been reviewed in a small number of studies (Kittel et al., 2020a; Kittel et al., 2023; Lindsay et al., 2023); however, a differentiated evaluation of the subjective benefit assessments was only carried out in individual cases (Rosendahl et al., 2023). Therefore, a comparative study with conventional video technology was conducted to address the missing evaluation of the benefit assessment of 360° videos as visual training support for movement acquisition, and to determine the subjective benefit assessment of the trainees, based on the well-recognized technology acceptance model (TAM) by Davis (1989) and following its extension model, the unified theory of acceptance and use of technology (UTAUT) by Venkatesh, Morris, Davis, and Davis (2003). According to the TAM, the subjective utility evaluation of digital technologies can be derived and determined from the three variables of perceived usefulness, perceived ease of use, and subjective attitude toward digital media.

Definition of terms

In 360° videos, video recordings of the real environment are created around a special 360° video camera (Ranieri, Luzzi, Cuomo, & Bruni, 2022). In the 360° videos, the viewing angle is subsequently freely selectable by the user in a 360° panoramic view around the camera (Roche, Kittel, Cunningham, & Rolland, 2021). Such individually controllable options are referred to as *degrees of freedom* (DoF). In a 360° video, the user can control individual gaze rotations on the X-, Y-, and Z-axes around the fixed point of the camera (Griffin, Langlotz, & Zollmann, 2021) and freely look up, down, left, or right or tilt in the 360° video recording. By comparison, virtual reality (VR) applications offer translational movements forward and backward, horizontal or vertical movements, in addition to rotations around the camera; thus, there are three additional DoFs that enable movements in the digital scenario (Griffin et al., 2021). Furthermore, these are predominantly programmed environments, and thus action manipulation is possible. However, in 360° videos, influencing the recorded action is not very feasible (Roche et al., 2021). The necessary requirements for programming skills for the creation of VR applications are therefore estimated to be quite higher and more elaborate compared to 360° video recordings (Jensen & Konradsen, 2018; Kavanagh, Luxton-Reilly, Wuensche, & Plimmer, 2017; Lindsay et al., 2022).

In addition, 360° videos can be viewed via different playback media with different degrees of immersion, thus picking up on the immersion function of VR. While the immersion concept refers to the mental level, immersion describes the feeling of reality in a non-physical world (Ranieri et al., 2022); on the technical level, however, immersion refers to the specific playback medium that enables a high feeling of reality (Dörner, Broll, Grimm, Jung, & Göbel, 2019). Both 360° videos and VR can be systematized according to the type of media used and their level of immersion (Dhimolea, Kaplan-Rakowski, & Lin, 2022; Kaplan-Rakowski & Gruber, 2019). Low-immersive VR is defined as applications controlled with a keyboard or mouse on the desktop, while high-immersive VR is defined as applications controlled with a head-mounted display (HMD), among others (Kaplan-Rakowski & Gruber, 2019; Le Noury et al., 2022).

The immersive potential of 360° videos with HMD has positive effects, especially on motivation and engagement (Kittel et al., 2020a; Rosendahl & Wagner, 2022; Rosendahl & Wagner, 2023a) and presents video content more authentically and realistically than conventional videos (Kittel et al., 2023; Lindsay et al., 2023), for example, regarding problem-based learning content or for presenting teaching–learning situations in physical education teacher training (Kittel et al., 2023). On the other hand, the benefits of high immersion themselves must be questioned (Boyer, Rochat, & Rix-Lièvre, 2023). Depending on learning content, a high degree of immersion combined with a high degree of presence opens up possibilities for the acquisition of movement, especially since the movements can be imitated or traced with free limbs when using an HMD (Lindsay et al., 2023; Rosendahl et al., 2022). For purely observation purposes, the individually controllable multiple viewing option is seen as a high potential of 360° videos (Rosendahl et al., 2023), which in turn can also be used less immersively as a desktop application (Rosendahl & Wagner, 2023a).

The different uses of the term "immersive" and the lack of a clear definition of 360° videos and VR make it difficult to provide clear statements about 360° videos as a training tool and teaching or learning medium (Rosendahl & Wagner, 2023a). Therefore, we advocate considering 360° videos separately from VR (Roche et al., 2021) and understanding 360° video technology as a link between videos and VR applications, which should, however, be classified as a specific video format due to the design process but with the characteristics of VR applications (Rosendahl & Wagner, 2023a).

Methods

Sampling

A total of 50 students in the fifth semester as part of the module "Sport as a stress modulator with fascial movements" of the BA program "Sport-Health-Leisure-Education" of the Karlsruhe University of Education, took part in the study. Two persons were excluded from the evaluation because their questionnaires were handed in incomplete. In the included sample ($N = 48$), 51.1% of the participants were female with one missing statement. The mean age of the sample was 22.35 years ($SD = 2.173$), with two missing statements (**Table 1**; **Fig. 1**).

Abstract

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Abstract

A 360° video combines the potential of conventional video technology with immersive–interactive design opportunities. The multi-perspective viewing option within a 360° video also enables possible applications as visual training support for motor learning. There are already first methodological–didactic approaches to movement learning; nevertheless, research on 360° video technology can largely be classified as exploratory. This article presents the use of 360° video as a visual training aid for the independent movement acquisition of various fascial movement exercises. In an intervention study, two randomized groups ($N=48$) were used to evaluate the subjective benefit. Following the technology acceptance model, subjective benefit perception and rating of format were compared after two crossover interventions with 360° videos and/or conventional training videos. No significant differences were found for perceived usefulness ($z=-1.014$, $p=0.31$, $r=0.105$) or perceived ease of use ($z=-1.278$, $p=0.201$, $r=0.132$). The same applies for intensity of use ($z=-0.247$, $p=0.805$, $r=0.025$) and overall subjective rating ($z=-1.745$, $p=0.081$, $r=0.18$). Although no significant differences were found in the evaluation of benefits, the participants tended to use 360° videos as visual training support ($M=3.4$, $SD=1.581$) on a 7-point scale (1 = 360° videos). Although a generalized statement on 360° videos as visual training support is not possible due to low effect strengths, it can be stated that 360° videos are perceived at least as useful as visual training tools.

Keywords

360° video · Digital motion learning · Digital training · Immersive video technology · Video learning

Research design

To determine the subjective benefit assessment of 360° video technology as a visual training support for the independent learning of eight fascial movement exercises compared to conventional training videos, eight 360° videos and eight conventional training videos were used as visual training support in an exploratory randomized intervention study with a cross-over design (◘ **Fig. 2**). The participants were given the task of learning eight fascial movement exercises with printed movement instructions and four 360° videos and four conventional training videos as visual training support during a 90-min seminar session; their benefits were also evaluated using a questionnaire based on the TAM (Davis, 1986; Davis, 1989) and the UTAUT model (Venkatesh et al., 2003). After four movement exercises with the corresponding video format, the questionnaire response was given directly, followed by the other four movement exercises with a different video format and subsequent survey. In addition, previous knowledge and user experience with 360° video technology and conventional videos were surveyed in order to classify the processing of 360° videos and their benefits. Finally, a survey was conducted on the tendency to prefer a video format for visual training support and on the positive and negative aspects of the different video formats.

Materials

The fascial movement exercises were all taken from the "fascial low intensity" program (Fessler & Müller, 2020). As part of the specific module "Sport as a stress modulator with fascial movements" in the fifth semester of the BA program "Sport-Health-Leisure-Education" of the Karlsruhe University of Education, the program "fascial low intensity" by Fessler and Müller (2020) is included as basic literature for the students. Two exercises of each of the five myofascial pathways were selected to address the fascial training principles of mobilization, stretching, toning, and vibration. A detailed written description of the fascial movement exercises was provided to the participants from the individual book chapters, and visual training support was provided by short, approximately 20-s 360° videos (◘ **Figs. 3 and 4**) and conventional video clips (◘ **Fig. 5**) of the targeted final movement execution, with an auditory explanation.

For this study comparing conventional videos with 360° videos, the 360° videos of fascial movements of four models in a diamond formation around the Insta360 ONE RS twin-edition camera were recorded in 4K image resolution and edited with the Insta360 Studio editing software. In contrast to the exploratory 360° video recordings, the professional training videos of the fascial low-intensity program of Fessler and Müller that were included (2020) were created within the framework of the project "Beyond school – Flexible careers in pedagogical professions" (2014–2020; total volume 2.1 million Euros) supported by the German Federal Ministry of Education and Research. These videos were recorded in HD in a video studio environment with three highly professional broadcast cameras, each with different, changing camera perspectives (close-up or overall view) and camera angles over several months and professionally edited over a period of 1 year with Final Cut Pro for commercial release in combination with the fascial low-intensity program by Fessler and Müller (2020).

The video clips, each in 360° video format and conventional video format, were created according to the randomized groups in two separate video playlists on YouTube, the links of which were sent to each group online. Since the immersive potential of 360° videos was not to be explored, and the handling and application of the two video formats as visual training support were to be implemented as simply as possible and without further technical aids other than PC, mobile phone, or tablet, the 360° videos were not viewed with an HMD. The students were free to view both video formats with their mobile phone, tablet, or PC in the sense of a "bring your own device" approach.

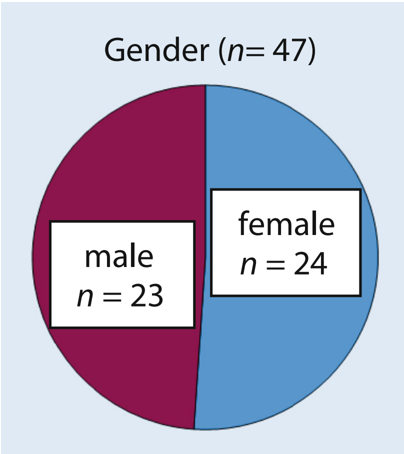

Fig. 1 ▲ Gender of test subjects

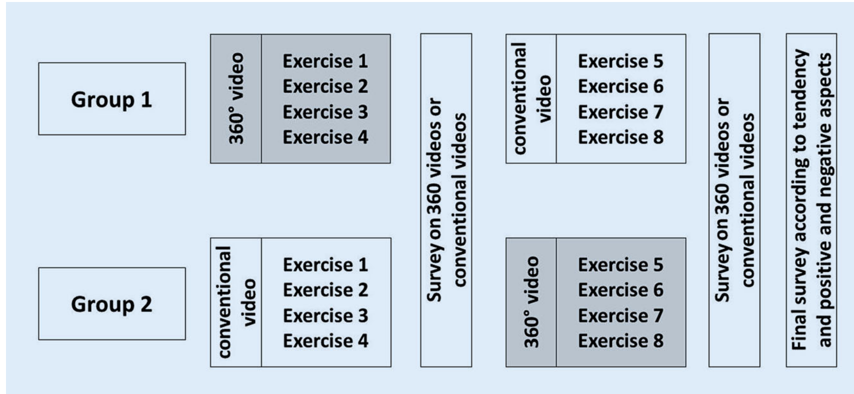

Fig. 2 ▲ Design of the study

Measuring instruments

Two questionnaires corresponding to the video format used were applied for the survey to assess the usefulness of the two video formats after each of the four movement acquisitions of the fascial movement exercises. To determine prior experience with each video format, questions were asked about intended use for entertainment purposes, specifically for fitness issues, as a learning medium, or no previous experiences. The questionnaires corresponded to the measurement instruments based on the TAM by Davis (1986; Davis, 1989), the extension by the UTAUT (Venkatesh et al., 2003), and the adapted reformulation of the questionnaire items by Pletz, Lemke, and Deininger (2020) suitable for VR applications. The evaluation was predominantly based on a 7-point Likert scale (1 = *does not apply at all*, 4 = *partially applies,* and 7 = *applies very much*). In addition, a subjective evaluation of the respective video format as visual training support was queried (10 items, e.g., "The fascia movement exercises are clearly conveyed in the 360° videos/conventional videos"). Finally, the tendency to choose a video format was asked after the intervention ("If you had to choose a visual training support for independent movement acquisition, which teaching–learning medium would it be?"; 1 = *360° videos*, 4 = *partly–partially*, and 7 = *conventional videos*) and in open-ended items for positive or negative aspects.

Technology acceptance

Based on the TAM (Davis, 1986; Davis, 1989) and considering the UTAUT (Venkatesh et al., 2003), ratings of perceived usefulness (four items, e.g., "I find the 360° videos/conventional videos useful as a visual training support"), perceived ease of use (four items, e.g., "360° videos/conventional videos are easy to use as visual training support"), and intention to use (four items, e.g., "If 360° videos/conventional videos are available, I would use them as visual training support for movement acquisition of fascia movement exercises") were adapted from the questionnaire modeled for VR by Pletz et al. (2020). According to the thematic focus on movement and sport and the university setting, the questionnaire items were adapted and profession- or work-relevant phrases from the original questionnaire (e.g., "If I use the technology, the probability of a salary increase increases") were modified (e.g., "360° videos/conventional videos facilitate my movement acquisition of fascia movement exercises") or omitted.

Data analysis

The evaluation was carried out with the statistical program SPSS version 29, where an alpha level of 0.05 was used for all statistical tests. In the context of the query of interest and the overall evaluation, negatively polarized items were used in isolated cases, such as those that queried the evaluation as boring or for indifference. For these items, the polarity was reversed so that the highest characteristic expression could be associated with a positive interest rating. For the utility rating of the two video formats, the individual items of the respective categories "interest," "perceived usefulness," "perceived ease of use," "intention to use," and "rating" were combined according to the TAM to form a latent variable for the respective video format and, since the prerequisites were not met with the Kolmogorov–Smirnov test for parametric tests, were analyzed with the Wilcoxon signed-rank test. Responses to the positive and negative aspects of the 360° videos from the open-ended survey at the end of the intervention are presented as examples to illustrate the quantitative results.

Results

Utilization

In addition to the sociodemographic information (Table 1), the participants' previous experiences with the two video technologies were documented (Fig. 6). Accordingly, within the item "usage behavior," multiple answers were used to ask about the use of both video formats for "entertainment purposes," as a "fitness and training device," as a "teaching and learning medium," or "not used in any way." The clear majority of participants (89.1%) had not yet used 360° videos in any form (Table 2). Only five participants used 360° videos for enter-

Table 1 Sociodemographic data of the participants	
	Age (years)
Valid	46
Missing	2
Mean	22.35
Median	21.50
Standard deviation	2.173
Range	9
Minimum	20
Maximum	29

Table 2 Utilization and purpose of 360° videos and conventional videos					
		360° videos for entertainment	*360° videos for fitness training*	*360° videos as a learning tool*	*360° videos not used in any way*
N	Valid	46	46	46	46
	Missing	2	2	2	2
Mean		0.11	0.02	0.02	0.89
Median		0.00	0.00	0.00	1.00
Standard deviation		0.315	0.147	0.147	0.315
Range		1	1	1	1
Yes		5	1	1	41
No		41	45	45	5
		Videos for entertainment	*Videos for fitness*	*Videos as a learning tool*	*Videos not used in any way*
N	Valid	44	44	44	44
	Missing	4	4	4	4
Mean		0.84	0.75	0.80	0.09
Median		1.00	1.00	1.00	0.00
Standard deviation		0.370	0.438	0.408	0.291
Range		1	1	1	1
Yes		37	33	35	4
No		7	11	9	40

tainment purposes. Compared to traditional video technology, where 9.1% of participants reported not using video in any form, video technology was used for entertainment purposes (84.1%) as well as a teaching and learning medium (79.5%) and a fitness tool (75%), as expected. The low level of prior experience of the participants with 360° videos supports the statements of Kittel et al. (2023) that the possible applications and potential of 360° video technology, particularly in sports, are not well known and researched.

Thematic interest

Singular interest in 360° videos as visual training support ("I find 360° videos/conventional videos interesting as visual training support") was not significantly different from interest in conventional training videos ($z = -1.654$, $p = 0.098$, $r = 0.271$). Nevertheless, the participants showed high thematic interest in both 360° video technology ($M = 6.02$, $SD = 1.17$) and conventional training videos ($M = 5.7$, $SD = 1.093$) for visual training support.

Comparison of the two latent variables "K1-topic interest-360° videos" and "K2-topic interest-conventional videos" also revealed no significant difference ($z = -0.507$, $p = 0.612$, $r = 0.05$) (**Table 3**). For both 360° videos and conventional videos, the participants expressed high thematic interest in the latent construct (360° videos: $M = 5.69$, $SD = 1.185$; videos: $M = 5.73$, $SD = 0.79$).

To rule out that the predominant lack of prior experience of the participants with 360° video technology led to a lack of interest in the technology, a correlation between the lack of prior experience (89.1% = "not used in any way") and thematic interest as a latent variable ("K1-topic interest-360° videos") was calculated with Pearson–chi correlation. In a second correlation, the existing prior experiences (10.9% = "entertainment purposes," 2.2% = "fitness and training device," 2.2% = "teaching and learning medium") were summarized as a latent variable ("K11 experience-360° videos") and tested for the relationship to thematic interest as a latent construct ("K1-topic interest-360° videos") using Spearman correlation. Both the results of the Pearsons–chi correlation ($p = 0.332$) and the results according to Spearman ($p = 0.132$, $r = 0.225$) indicate no significant correlation between lack of prior experience with 360° video technology and thematic interest. The small effect size also suggests that even without prior experience in using 360° videos, a tendency toward high interest in this rather newer technology as a training tool was thus possible. Due to the lack of correlations and the low effect size, it can be assumed that prior experience in the use of 360° videos did not influence the thematic interest in this technology.

Perceived usefulness

A significant difference in the rating of the singular item ("I find the 360° videos/conventional videos useful as visual training support") was not found ($z = -0.038$, $p = 0.97$, $r = 0.004$). For the singular item, participants rated both 360° videos ($M = 6$, $SD = 1.504$, $R = 6$) and conventional videos ($M = 6.11$, $SD = 0.875$, $R = 3$, $min = 4$) as useful visual training support, with slight advantages for conventional videos.

A comparison of the two latent variables, "K3-Perceived usefulness-360° videos" ($M = 5.87$, $SD = 1.268$) and "K4-Perceived usefulness-conventional videos" ($M = 5.85$, $SD = 0.702$), revealed no significant difference ($z = -1.014$, $p = 0.31$, $r = 0.105$).

Perceived ease of use

No significant difference ($z = -1.333$, $p = 0.183$, $r = 0.137$) was found in the singular item evaluation ("360° videos/conventional videos are easy to use as visual training support") or in the singular item evaluation ("I find the 360° videos/conventional videos easy to control"; $z = -1.827$, $p = 0.068$, $r = 0.188$). Both video formats were described as easy to

Fig. 3 ◀ All four possible viewing perspectives in a 360° video recording, shown in panoramic view

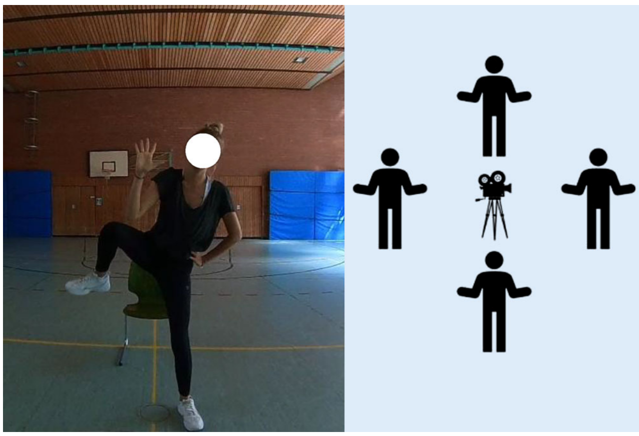

Fig. 4 ▲ One possible viewing perspective in a 360° video with specific 360° video recording setting

Fig. 5 ▲ Viewing frontal perspective in a conventional video with specific conventional video recording setting

use (360° videos: $M=5.85$, $SD=1.351$; videos: $M=6.19$, $SD=0.97$) and easy to control (360° videos: $M=5.89$, $SD=1.418$; videos: $M=6.32$, $SD=0.958$), with slight advantages for conventional videos. This is also reflected in the range of the responses (360° videos: $R=6$; videos: $R=3$, $min=4$).

Comparison of the latent variables "K5-Perceived Ease of Use-360° Videos" ($M=6.04$, $SD=1.037$) and "K6-Perceived Ease of Use-Conventional Videos" ($M=6.28$, $SD=0.699$) showed no significant differences in perceived ease of use ($z=-1.278$, $p=0.201$, $r=0.132$), confirming a simple control for both.

Intention of use

The singular item value ("If 360° videos/conventional videos are available, I would use them as visual training support for movement acquisition of fascial movement exercises") is not significantly different from the other ($z=-1.562$, $p=0.118$, $r=0.161$) and, when available, shows high intentions to use for both 360° videos ($M=5.62$, $SD=1.483$, $R=6$) and with slight advantages for the conventional video technique ($M=6$, $SD=0.978$) with a lower range of attributed intentions to use ($R=3$, $min=4$).

Comparison of the latent variables "K7-estimate of intensity of use-360° videos" and "K8-estimate of intensity of use-conventional videos" also showed no significant difference ($z=-0.247$, $p=0.805$, $r=0.025$) in subjectively assessed intensity of use (**Table 3**).

Rating

In the latent variables "K9-evaluation of the medium 360° videos" and "K10-evaluation of the medium conventional videos," no significant differences with a small effect size were found in the final evaluation of the two video formats as visual training support ($z=-1.745$, $p=0.081$, $r=0.18$). Both 360° videos ($M=5.8$, $SD=0.918$) and conventional videos ($M=5.62$, $SD=0.732$) were predominantly positively evaluated as visual training support, with conventional video technology ($R=2.8$, $min=4.2$) showing a significantly more homogeneous range of evaluation than 360° videos ($R=4.3$, $min=2.7$).

Even though no significant differences in the assessment of the usefulness of 360° videos and conventional video technology as visual training support were identified, the participants tended to use 360° videos as a future video format for visual training support ($M=3.4$, $SD=1.581$). In particular, the feedback from the open-question categories showed positive assessments regarding the free choice of perspective as well as the viewing of movements from both the frontal and sagittal planes ("With the 360° videos, it was very positively noticed that you can freely choose the perspective. The viewing angle is adjusted as desired. This allows you to focus more on details."). This multi-perspective view of movements leads to a vivid and differentiated representation of movements ("vivid, movement visible from all sides, more differentiated"). In contrast to the strikingly frequently mentioned multi-perspective viewing option as a positive potential of 360° videos as visual training support, the individually controllable viewing direction was evaluated by individual participants as confusing ("much too confusing") and overwhelming ("Since you could focus on several people and viewing angles at the same time, you would have to

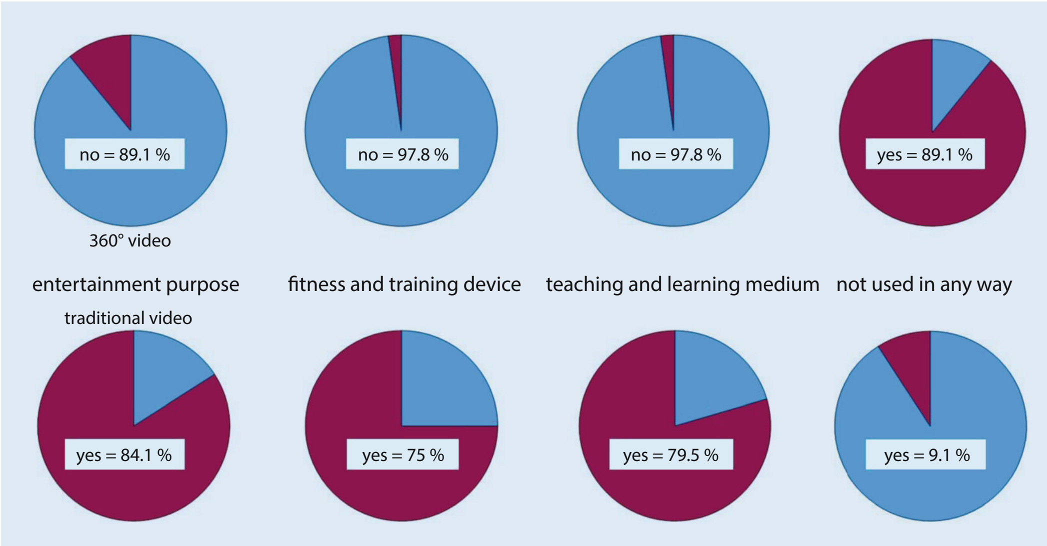

Fig. 6 ◀ Utilization and purpose of 360° videos and conventional videos

know beforehand which movement and perspective you want to analyze"). The individual differences in the movement execution of the role models in the 360° videos also led to confusion for some participants regarding the movement executions that were specifically shown and rated as optimal ("The four people should perform the exercise in the same way, as it is confusing if the body posture is different").

Discussion

The main focus of our exploratory study was to evaluate the utility of 360° videos as visual training support. To this end, two research questions were posed:

1. What advantages do students attribute to the two different video formats as visual training support for movement acquisition?
2. How do students evaluate two different video formats as visual training support for independent movement acquisition?

The results show no significant differences in benefit ratings between 360° videos and conventional video technology as visual training support. The small effect size also indicates that the small differences do not allow for a clear statement about a higher benefit rating for a specific video format. This should be evaluated critically and limits clear statements about the preferred video format. It is assumed that with comparable video recordings, especially due to the equivalent recording quality and movement execution and with longer video duration, the effect size allows for clearer statements about the different evaluation of the benefits of the video formats. However, the low effect size can also be interpreted in this way, that despite the limitation in the study due to the different video quality, the high-quality conventional videos were not rated better.

However, the homogeneous evaluation behavior of the participants for conventional video technology in the individual categories of the TAM, as well as in the overall evaluation, is striking, whereas 360° videos had a heterogeneous evaluation spectrum in all categories. It can be assumed that the rather heterogeneous evaluation behavior for 360° videos is due to the unfamiliar video format, as shown by the scarcely available empirical data (Kittel et al., 2020b; Paraskevaidis & Fokides, 2020). Conventional videos as visual training support, on the other hand, are already familiar to the participants, both in terms of control and handling as well as potential benefits, as also confirmed by Paraskevaidis and Fokides (2020) in their study on volleyball skill acquisition with 360° videos. Nevertheless, the survey on thematic interest in both conventional videos and 360° videos shows curiosity about their use as visual training support, even if conventional videos are already familiar. The lack of previous experience with 360° video technology tends not to affect interest in the technology. Nevertheless, a possible novelty effect of 360° video technology should be evaluated critically. However, since 360° videos predominantly without prior experience and conventional videos with a majority of familiar use both generate interest, the novelty effect of 360° videos tends to be of minor relevance.

Although no significant differences were identified in the benefit assessment of the two video formats, a tendency toward 360° videos as visual training support was evident among the participants. This tendency could be due to the high motivational potential of 360° videos (Paraskevaidis & Fokides, 2020) and support Kittel and colleagues' (2020a) assumption that 360° videos are more entertaining to evaluate than screen-based approaches.

In our opinion, attributing the motivation and trend of the future use of video formats solely to a possible novelty effect of 360° videos (Hebbel-Seeger, 2017) falls short of the mark because the positive aspects of 360° videos mentioned earlier show clear differences from conventional video technology. The presumed advantages of the multi-perspective viewing possibility of movements for the acquisition of 360° videos from the methodological–didactic training concept of Rosendahl et al. (2022; Rosendahl & Wagner, 2023b) were recognized and named by the participants

Table 3 Wilcoxon test results of the latent variable constructs

	Latent variable	Latent variable	Latent variable	Latent variable	Latent variable
	K2 Interest conventional videos	**K4 Perceived usefulness conventional videos**	**K6 Perceived ease of use conventional videos**	**K8 Intention of use conventional videos**	**K10 Rating conventional videos**
	K1 Interest 360° videos	**K3 Perceived usefulness 360° videos**	**K5 Perceived ease of use 360° videos**	**K7 Intention of use 360° videos**	**K9 Rating 360° videos**
Z	−0.507[b]	−1.014[b]	−1.278[c]	−0.247[b]	−1.745[b]
Symp. Sig. (2-tailed)	0.612	0.310	0.201	0.805	0.081

[a]Wilcoxon signed rank Test
[b]Based on positive rank
[c]Based on negative rank

and support the statements and results of the qualitative survey on subjective perception and assessment of 360° videos as visual training support by Rosendahl et al. (2023). Viewing movements from freely selectable, different viewing angles enables a more detailed understanding of movements with the help of 360° videos as visual training support, which is not readily possible with conventional videos. At the same time, this free control of viewing direction is also unfamiliar, as reported by participants, confirming the findings of Boyer et al., (2023), Paraskevaidis and Fokides (2020), and Rosendahl et al. (2023), and requires a methodological–didactic concept for introducing the use of the technology to counteract blurring and disorientation in the 360° video (Paraskevaidis & Fokides, 2020; Rosendahl et al., 2022; Rosendahl et al., 2023). To address the disorientation caused by the freely selectable multi-perspective viewing option in the 360° video scenario, Boyer et al. (2023) and Roche et al. (2021) suggest integrating cues into the 360° video.

In the qualitative survey on the subjective perception of 360° videos as visual training support by Rosendahl et al. (2023), in addition to a possible disorientation in the 360° video scenario due to a lack of methodological–didactic concepts and diverse multi-perspective viewing options, the different movement executions of the role models in the 360° videos were also mentioned as negative, which led to confusion during movement acquisition. In contrast to the highly professional, conventional video recordings with video models in the commercial marketing of the fascial low-intensity program by Fessler and Müller (2020), only students who were familiar with fascial movements were recruited as exploratory models for the 360° video recordings. Nevertheless, these differentiated movement executions of the four role models in the 360° video situation can be used for analysis purposes (e.g., as a trainer in a training group to train the recognition of movement errors and to demonstrate error corrections). However, for independent learning of a targeted movement execution classified as optimal with the aid of 360° videos as visual training support, care must be taken to ensure that the four role models are executed correctly and as homogeneously as possible in the 360° video situation.

In addition to the differentiated movement execution of the four role models in the 360° video situation, the qualitative differences of the video formats should be mentioned as a limitation of our study. However, although there were major differences between the recording environments and especially between the recording and editing time efforts of the two video formats, there is no significant difference in the evaluation of conventional videos or 360° videos as visual training support. This is remarkable because both video formats differ mainly in the use of their resources. Conventional video technology requires at least two camera systems for motion display from different camera perspectives and an increased post-processing phase for synchronous montage of the different video recordings. In 360° video technology, on the other hand, multiple models are needed for a single video shot, which are placed around the camera position accordingly. While the conventional training videos were recorded and edited in a professional studio environment due to their commercial exploitation over a period of 1 year, the explorative 360° videos were recorded in a gym and were able to achieve high approval ratings as a visual training tool even with a total effort of 2 days. From our point of view, the 360° video technique is advantageous in terms of design effort, as it also enables individual control of the desired camera perspective by the user, which, however, initially appears unfamiliar to most users and requires some guidance and introduction. Especially the easy handling of this technology and the low effort hold potential as future visual training support.

Despite this significant difference in the quality of the recording design, the 360° videos were rated as providing the same level of visual training support as the professional conventional training videos. Thus, 360° videos are believed to have great potential as visual training support if they are also available in equivalent recording quality. However, the actual usefulness of 360° videos as visual training support for movement acquisition in the context of a qualitative movement assessment cannot be determined with our study and is not part of the present article. Measuring the learning and training success of 360° videos would therefore be the next research step.

Conclusion

Due to the nonsignificant results and the small effect size, clear statements on the different benefit evaluations of 360° videos and conventional video technology as visual training support are not possible. Nevertheless, it can be stated that 360° videos were rated as useful visual training support despite the lower recording quality and did not show a significant negative utility rating compared to highly professional conventional training videos. Similarly, a trend in future video use toward the 360° video format is evident (Rosendahl et al., 2023). Future research should focus on further comparisons of the two video formats with equivalent recording quality.

Based on our results, we can conclude that 360° videos adopt the training potentials of conventional video technology and expand them without much creative effort through multi-perspective observation of movement. As visual training support, 360° videos are, therefore, at least as suitable as conventional training videos. In addition, the potential of 360° videos has not yet been fully exploited, as there is still a lack of experience in using this video technology, especially since methodological–didactic concepts for its use in sports are largely lacking. A methodological–didactic concept and guided use of 360° videos can counteract cognitive overload, loss of focus, and disorientation in a 360° video setting (Boyer et al., 2023; Rosendahl et al., 2022).

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Declarations

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