The emergence and development of attitudes of students towards the use of video-based media in physical education

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ABSTRACT

The incorporation of video-based media in physical education has received limited attention in empirical studies concerning students' attitudes. To grasp a holistic understanding of how these attitudes manifest and evolve, it's essential to consider the specific teaching methods alongside broader factors shaping attitudes towards media usage. Drawing from the Technology Acceptance Model (Alsharida et al., 2021; Davis, 1989; Venkatesh et al., 2012) and attitude measurement research, a structural equation model was employed to probe attitudes towards video-based media adoption in physical education. This study involved 202 secondary students (M_{age} = 13.26; SD_{age} = 0.54, 49% female), examining the interplay between external variables and attitude dimensions. The findings indicate that access to video-based media and self-efficacy in learning with such media bolstered perceptions of usability and usefulness. One-dimensional concepts regarding the centrality of physical movement and appropriate design choices decreased. Interestingly, perceived usability and perceptions regarding movement centrality and design didn't directly impact usage intentions. However, improved usability and reduced concerns about movement centrality and design led to a more favorable evaluation, consequently boosting intentions to utilize video-based media in physical education. Educational interventions should underscore the advantages of incorporating media into physical education, aiming to enhance students' self-efficacy and mitigate negative attitudes. Of particular importance is the affective evaluation of video-based media usage, as it appears pivotal in determining actual usage.

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Keywords

physical education; attitudes; video-based media; Technology Acceptance Model

Introduction

Digital media shapes the culture of human activity and sports in a variety of ways. You can follow Ronaldo on Instagram, post a photo of a beach volleyball game at the lake, follow American football in a live stream and record your own running route via an app and thus take part in the virtual running group's challenge. As a result, physical education classes that focus on students' everyday experiences must incorporate digital media usage significantly, especially since the integration of digitalization in schools is now a national and international mandate (Shell, 2019; Vuorikari Rina et al., 2022). In this context, educational institutions are tasked with fostering skills that help students engage responsibly, confidently, and actively in a digitalized society (Shell, 2019, p. 6). Media consumption has surged over the past two decades (Rideout & Robb, 2020; Shell, 2019). Nonetheless, the perception that young people view digital media use in schools positively and enjoy using it for learning (Oblinger & Oblinger, 2005) may be outdated. Research indicates that this perspective oversimplifies children's and adolescents' attitudes towards digital media in education, prompting a need for a more nuanced understanding of these relationships (Jones et al., 2010). Holistic media didactic target perspectives go beyond the development of media technology skills and knowledge and also include the media-related attitudes and values of users. Therefore, the recording of media-related attitudes is becoming increasingly important as a prerequisite for the empirical examination of intended effects in the area of digitalization-related learning processes.

Students' as well as teachers' attitudes toward digital media have been examined several times in recent years (Howard et al., 2016; Petko et al., 2018). The findings suggest that media use in schools can positively affect students' and teachers' attitudes toward digital media. However, the results also reveal that particularly students' attitudes toward media use in educational settings are not as uniformly positive as previously believed (Jones et al., 2010) , making it challenging to draw clear conclusions. For example, Yasin et al. (2020) pointed out that media related attitudes depend on the self-efficacy (the belief that one has the capability to perform a particular behavior) of the learner in educational settings. Yet, it appears that students' media-related attitudes are a critical factor for media use both within and outside school settings, and thus a key focus of media didactic efforts. Despite numerous studies on various aspects of digital media in physical education in recent years—such as research on the Digital Video Games Approach (Price et al., 2022)or digital media use in elementary schools (Greve et al., 2022)—a significant research gap remains, particularly in physical education. In this field, media, especially video feedback, is often employed to enhance motor learning processes (Mödinger et al., 2021). The theoretical basis is the motor approach, which is grounded in information theory and posits that movement representations can be centrally stored and retrieved as needed (R. A. Schmidt, 1975). More recent approaches classify video feedback in motor learning as a form of augmented feedback. It provides external representations of the movement

that complement the inherent feedback and thus promote motor learning (R. Schmidt & Lee, 2019). During the learning process, these movement representations are reinforced and refined (Mödinger et al., 2021), with visual video feedback providing retrospective insights into successful and incorrect aspects of previously performed movements (Olivier & Rockmann, 2003). Since the use of digital media in physical education is dominated by the use of videos (as demonstration or feedback videos), digital media are specified as video-based media within the scope of the study. The primary objective is to understand students' attitudes toward the use of video-based media in physical education.

The didactic relevance of students' attitudes towards the use of video-based media in physical education unfolds both in and out of school: From the knowledge of students' attitudes and their genesis, consequences for the didactic staging of the use of video-based media in physical education can be derived. In addition, it has not yet been clarified to what extent the reference to movement in the subject of physical education influences students' attitudes, so that the question of subject-specificity and generalizability of their genesis cannot yet be answered on the basis of evidence. In addition, the curricular and educational plans for the subject of sport include the curricular requirement to support the introduction to the culture of movement, play and sport in addition to promoting development through movement, play and sport (Ministry of Culture, Youth and Sport Baden-Württemberg, 2016). Since digital media plays a central role in this extracurricular culture today (e.g. Wendeborn, 2019), the media-related attitudes of pupils do not only concern media use in school contexts, where the choices are often limited by the lesson design and the framework conditions. In terms of promoting physical activity, findings also indicate that the sports-related media use of young people has an increasing influence on the amount of sports activity (Braumüller & Hartmann-Tews, 2017).

Attitudes and Attitude Measurement

A crucial aspect of the study is the psychological construct of attitude. Attitudes are general evaluations that can pertain to oneself, others, objects, or situations (Mummendey & Grau, 2014; Thurstone, 1928) and are formed based on experience. They comprise cognitive, affective (affective), and behavioral components, with a strong emphasis on the affectiv component (Rosenberg & Hovland, 1960). Accordingly, attitude is defined as a learned tendency to assess categories of objects or people 'favorably' or 'unfavorably' based on one's beliefs and feelings (Zimbardo & Gerrig, 1996, p. 521). In this multidimensional attitude construct, the cognitive component pertains to a person's beliefs, thoughts, and knowledge about video-based media in sports (e.g., usability, usefulness). The affective component relates to a person's emotional reaction or feelings towards video-based instruction (favorable or unfavorable), and the behavioral component concerns a person's inclination to act in a particular manner towards video-based media (e.g., actual use or engagement with video-based digital media). This term must be distinguished from the concepts of perspective (the way individuals view the world around them in general) and perception (interpreting the world based on sensory information).

In recent years, several studies have examined students' perceptions of physical education (PE) (Chung & Phillips, 2002; Li et al., 2014; Ntovolis et al., 2015; Subramaniam & Silverman, 2000). Most of these investigations concentrate on the impact of attitudes related to PE and participation in extracurricular sports, while students' views on the use of media in PE have not been considered so far. For instance, research indicates that posi tive attitudes towards PE can encourage students to develop healthy, active lifestyles that persist beyond their teenage years (e.g. Hagger et al., 2003; Harris, 2014; McKenzie, 2003) and continue into adulthood (Kohl & Hobbs, 1998; Subramaniam & Silverman, 2007). In his review of attitude research in physical education, Silverman (2017) describes that all longitudinal studies show that

pupils' attitudes towards physical education deteriorate with increasing age, whereby this negative development of attitudes affects girls more than boys. Several studies show the connection between enjoyment and fun experienced in PE lessons and positive attitudes towards PE lessons (Gråstén et al., 2012; Prochaska et al., 2003). In addition, there is evidence that low motor skills and a strong competitive orientation in physical education are associated with negative attitudes towards physical education (Bernstein et al., 2011). Concerning the modifiability of attitudes related to PE, it also seems that they can be shaped by meaningful experiences, relationships, and enhanced self-efficacy (Digelidis et al., 2003; Potdevin et al., 2018; Sigrist et al., 2012).

Attitudes are often measured explicitly with subjective methods (semantic differentials (SD) or brief statements) rated on scales (Hair et al., 2019). These ratings reveal how individuals are disposed towards specific topics. Previous studies have measured attitudes in the context of video-based media use in a basic manner, using only a few items (Davis, 1989; Venkatesh et al., 2012). However, from a psychological perspective, employing a more comprehensive questionnaire that captures the attitude construct in greater detail across all dimensions is appropriate (Zimbardo & Gerrig, 1996). Therefore, a rating scale that encompasses all components of the psychological attitude construct is used for this research project (Osgood et al., 1957). Evidence indicates that rating scales are effective in recent studies on (general) attitude measurement (e.g. Opper, 2013; Reschke & Jude, 2022) and can explicitly account for all dimensions through specific item formulation. It must be acknowledged that attitudes may be implicit, and social desirability effects concerning sensitive topics may prevent bias-free attitude measurement using differentials (Garms-Homolová, 2020). However, attitudes towards media use or media content are considered non-sensitive constructs, supporting the use and sensitivity of SD (Neumann et al., 2018). Since our aim was to measure a very specific attitude—attitude towards video-based media use in physical education—an appropriate scale was developed and validated (Beege et al., 2024) in order to have a suitable measurement tool for measuring students' attitudes towards media use in physical education, which is used in this study to assess current attitudes.

Media Related Attitudes

To date, empirical research on students' attitudes towards video-based media in physical education is scarce, and the development of students' technology-related attitudes and beliefs remains largely unexplored (Petko et al., 2018) . However, technology acceptance models (Alsharida et al., 2021; Davis, 1989; Venkatesh et al., 2012), which are based on the Theory of Planned Behavior (Fishbein & Ajzen, 1977), indicate that attitudes are crucial for predicting future media-related behaviors (see Figure 1). Consequently, this study employs the Technology Acceptance Model (TAM), which is discussed in greater detail.

The Technology Acceptance Model (TAM) is utilized as a foundation for assessing students' attitudes toward the use of video-based media in physical education for two primary reasons: (1) the model illustrates that external factors can impact the development of attitudes, and (2) TAM effectively represents the three-component structure of the psychological construct of attitudes (usefulness corresponds to the cognitive component; "attitude" reflects the affective component; intention of use and actual use pertain to the behavioral component). However, previous implementations of TAM exhibit inconsistencies, particularly in the conceptualization and dimensionality of attitudes (e.g. Davis, 1989; Park, 2009). Moreover, they often neglect the affective component of attitude, which is only partially addressed in individual studies (Al-Rahmi et al., 2021), despite its potential importance (Rosenberg & Hovland, 1960).

The "unified theory of acceptance and use of technology model" derived from TAM (e.g. Chao, 2019) also fails to explicitly cover all three dimensions of attitude, particularly the cognitive component. Additionally, the influence of external variables varies significantly depending on the context or nature of the atti-

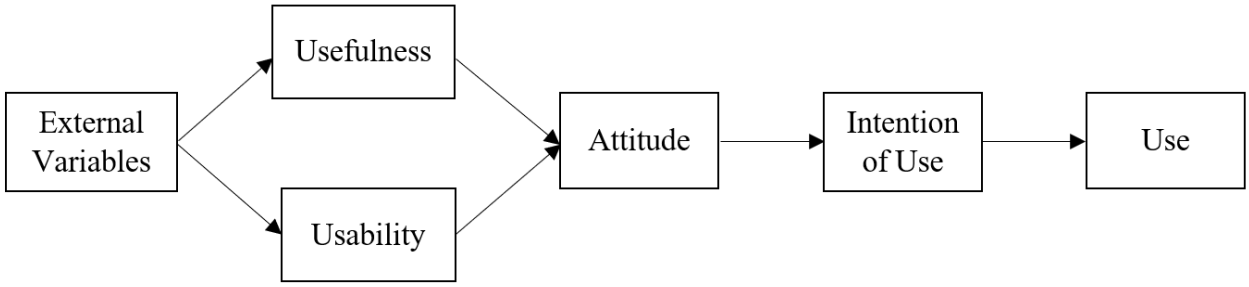

Figure 1 *Technology Acceptance Model (own representation)*

tude. In physical education, different external factors are relevant (e.g., private sports activity or access to media in sports education) compared to those considered in previous models (e.g., service quality or mobile anxiety), making it challenging to generalize the influence of attitudes on usage behavior. Increasing skepticism about the general validity of TAM and calls for necessary adaptations to specific application contexts are being voiced (Al-Emran & Granić, 2021).

Therefore, the scales of TAM were updated in a previous study (Beege et al., 2024) to accurately capture students' attitudes toward video-based media use in physical education and the external factors that significantly influence these attitudes. The revised scales will be used in this study in order to assess students' attitudes towards the use of video-based media in detail and to transfer relationships between individual dimensions into an empirical model. Previous research indicates that these attitudes are not universally positive (Jones et al., 2010). The underlying causes of this need to be investigated, and attitudes should be detailed based on their dimensions.

Research Model and Research Questions

Summarizing, the current study aims at creating a model (Figure 2) to specify attitudes towards video-based media use in physical education with all components and relevant external variables, and analysing the expression of attitudes as well as relations between external variables as well as attitude components.

In this vein, Beege et al. (2024) specified external variables, attitude components as well as sub-constructs which are based on research on attitudinal constructs from a psychological perspective in addition to previous research regarding the TAM. For a more detailed overview over the explanations of all included constructs, please review (Beege et al., 2024). However, a short explanation will be provided for each variable.

At first, we obtained external variables from previous TAM version (e.g. Park, 2009). According to Pituch & Lee (2006) system and learner characteristics are important when understanding the emergence and expression of attitudes within the TAM and thus, media norm (as social influence factor), access to video-based media in sports education (as organizational context variable), experience with video-based media use and self-efficacy (as individual success factors) were chosen. However, since this study has a strong focus on physical education, additional variables need to be considered. Private and school sports activities were included as these variables have been extensively researched in relation to sport-related attitudes in different theoretical contexts, for example in self-concept research (e.g. Eccles, 1983; Steffgen et al., 2000).

With regard to the cognitive component, we oriented on previous TAM versions again (Park, 2009). Thus, usefulness and usability were obtained as sub-constructs since prior research outlined important connections between these variables and the discussed external factors. Further, studies on the media-related attitudes of physical education teachers revealed subject-specific characteristics that have to be included

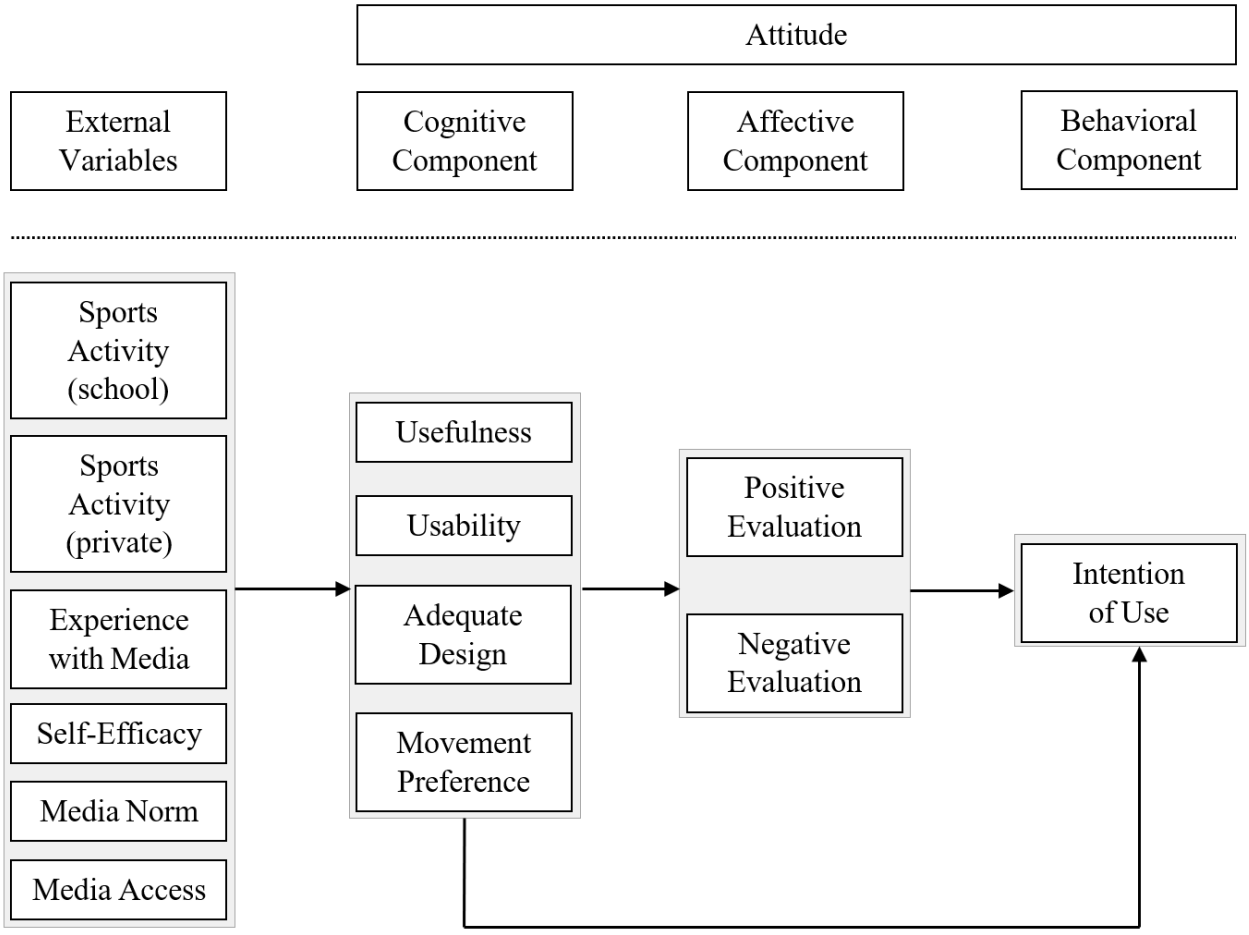

Figure 2 *Attitudes of students towards the use of video-based media in physical education (theoretical model).*

as sub-construct of the cognitive component as well because they might be relevant for students as well. There is a belief that physical education should primarily serve physical activity (Roth, 2022). As a result, sport didactic demands and target perspectives that go beyond the pure promotion of physical activity are not specifically addressed in physical education lessons. Consequently, use of video-based media might disrupt the goals of physical education since media reception could leave less time for the activity. In this context, the teacher plays a central role in guiding the focus by means of individual feedback (Mödinger et al., 2021). Consequently, both teachers and students may doubt that video-based instruction is appropriately designed for sport-related instructional purposes because the lack of individual feedback by the teacher cannot be compensated for by feedback options provided by videos.

Furthermore, there was a focus on the affective component of the attitude, since prior research often neglected this component (e.g. Al-Rahmi et al., 2021). Consequently, the affective component was measured in detail and both, positive and negative evaluations were measured. Finally, the behavioral component includes the intended use but not the actual use since actual use depends not only on the student perspective but also on decisions made by the teacher.

Based on the postulated model, the following research questions and hypotheses were formulated:

RQ1: What is the actual expression of students' attitudes towards the use of video-based media in physical education?

The first research question explores the actual expression of students' attitudes toward video-based media use on the basis of all three dimensions. The subconstructs of the attitude dimensions are analysed descriptively. Research findings indicate that students' attitudes toward media use are not as fundamentally positive as has been uncritically assumed before (Jones et al., 2010; Schulmeister, 2009).

RQ2: What is the relationship between external variables and attitude towards video-based media use in physical education?

To gain insight into the formation and maintenance of students' attitudes towards video-based media use in physical education, relationships between external variables and attitude are examined. Whereas some effects are analyzed exploratory, concrete hypotheses could be formulated for the following external variables:

H1: A positive media norm promotes perceived usefulness, usability and reduces perceived limitations of video design and motion preference.

H2: Experiences in media use promotes perceived usefulness, usability and reduces perceived limitations of video design and motion preference.

H3: High self-efficacy with respect to learning with media promotes perceived usefulness, usability and reduces perceived limitations of video design and motion preference.

H4: Access to media promotes perceived usefulness, usability and reduces perceived limitations of video design and motion preference.

RQ3: What are the relationships among the attitude components?

Last, relationships among components are examined to determine how both cognitive and affective components affect intention of use. Again, concrete hypotheses could be formulated for the following components:

H5: Higher perceived usefulness of media lead to more positive evaluation and increased intention of use media in physical education.

H6: A higher perceived usability of media leads to more positive evaluation and increased intention of use media in physical education.

H7: A lower perceived limitations of video design leads to more positive evaluation and increased intention of use media in physical education.

H8: A lower motion preference leads to more positive evaluation and increased intention of use media in physical education.

H9: A positive evaluation increases intention of use, a negative evaluation decreases intention of use media in physical education.

Methods

Participants

The model (Figure 2) was validated by conducting a structural equation model (SEM) (Bagozzi & Yi, 2012). With respect to an a-priori power analysis for SEMs (Jobst et al., 2021), the R-package semPower (Moshagen & Erdfelder, 2016) was used[1]. The model was con-

1. The model had 38 indicator variables and thus, 741 [0.5*(38*(38+1))] unique elements in the variance-covariance matrix of the empirical data. The model contains 129 free parameters (25 loadings, 6 variances and 15 covariances of

ducted using a secondary school student sample. This sample has high practical relevance for the research questions to be investigated since these students since they actively and regularly attend physical education classes. Overall, 202 8th grade students (M_{age} = 13.26; SD_{age} = 0.54) took part in the study. Forty-nine percent of the participants were female. Students were recruited in secondary schools in and around the cities of Freiburg and Dortmund in Germany. According to the data in Table 1, students overall had a positive perception of sports activity as well as a high experience and self-efficacy. However, media norm and access to media in physical education are perceived as low to medium. The students themselves and their legal guardians gave their written consent to participate in the study and the study received a unanimous positive vote from the ethic committee of the University of TU Dortmund University (Germany) without any conditions in September 2022.

Questionnaire

The used questionnaire was validated by (Beege et al., 2024). The questionnaire measured external variables with 17 items (private sports activity: ω = .86, school-related sports activity: ω = .92, experience: ω = .76, self-efficacy: ω = .79, media norm: ω = .81, access: α = .81). An example item was: "I like Physical Education classes.". The cognitive facet (usefulness: α = .74, usability: α = .82, adequate design: ω = .82, and motion preference: α = .75) was measured with 10 items. An example item was: "Videos will improve learning in Physical Education classes.". The affective facet (positive evaluation: ω = .83, and negative evaluation: α = .64) was measured with 5 items. An example item was: "I think it's good that videos are used in Physical Education.". The behavioral facet (intention of use) was measured with 6 items (ω = .87). An example item was: "In the next Physical Education lesson, I would like to see a video.". All items were assessed by the participants based on a 5-point Likert-type scale (1 = fully agree; 5 = do not agree). Overall, 38 items were used. The whole scale can be viewed in Appendix A.

Data Curation

Data were collected through two methods: firstly, a paper-pencil questionnaire was utilized; secondly, the questionnaire was digitally hosted using the open-source survey software *LimeSurvey*. During regular school sessions, students were administered either the paper or digital version of the questionnaire. Prior to completing the main questionnaire, participants were given a sample item to demonstrate how to respond to the rating scale. Subsequently, they filled out the entire questionnaire. Following this, demographic information was gathered. On average, the process took 10-15 minutes.

Analysis Plan

Descriptive analyses (RQ1) were carried out by conducting the arithmetic mean, median, standard deviation, as well as skewness and kurtosis of all sub-constructs, to get a descriptive insight in the expression of the attitude. The SEM (RQ2 and RQ3) was conducted using AMOS. External variables (private and school related sports activity, experience, self-efficacy, norm, access) were included as predictors. The cognitive component was used as stage one criterion (predicting the affective and behavioral component, predicted by the external variables). The affective component served as stage two criterion (predicting the behavioral component, predicted by the cognitive component). The behavioral component was added as stage three criterion (predicted by the cognitive and affective component). Since multiple effects should be explored as well as investigated based on the hypotheses, all potential paths between the sub-constructs were examined. The predictors (external variables) were correlated. Standardized β values were conducted for all paths and tested for significance. Following Hu & Bentler (1998), the model fit was checked

exogenous variables, 7 error terms of endogenous variables, 38 errors of indicator variables, and 38 slope parameters), leading to a df of 612 [741-129]. Assuming a RMSEA of .05, and a statistical power (1-β) of 90%, 74 participants should be acquired at least to validate the model.

relying on several indices, namely the comparative fit index (CFI; incremental fit measure), the root-mean-square error of approximation (RMSEA; absolute fit measure), and the χ^2/df ratio (parsimonious fit). Values greater than .90 are usually interpreted as an acceptable fit for the CFI (Bentler, 1990). Concerning the RMSEA, the value should not exceed the cut-off .10 (Browne & Cudeck, 1992). Considering the parsimonious fit, the ratio should be below 3.0 (Marsh & Hocevar, 1985).

Results

Descriptive Analysis

Descriptive values for all items are presented in Appendix A. Aggregated descriptive data for all sub-constructs are displayed in Table 1.

Table 1
Descriptive Data for all sub-constructs.

Sub-Construct	Mean (*SD*)	Median	Skewness	Kurtosis
External variables				
School-related sports activity	4.14 (1.01)	4.67	-1.10	0.33
Private sports activity	4.18 (0.99)	4.67	-1.12	0.57
Experience with media use	4.09 (0.85)	4.33	-1.08	1.11
Self-efficacy in media use	3.66 (0.86)	3.67	-0.58	0.08
Media norm	2.87 (0.87)	3.00	0.29	0.06
Access to media	2.43 (1.32)	2.00	1.32	-1.15
Cognitive component				
Usefulness	3.76 (0.89)	4.00	-0.35	-0.62
Usability	3.36 (0.99)	3.00	-0.12	-0.43
Adequate design	3.42 (0.86)	3.25	0.16	-0.86
Motion preference	3.11 (1.05)	3.00	0.08	-0.73
Affective component				
Positive evaluation	3.39 (1.02)	3.33	-0.36	-0.49
Negative evaluation	2.48 (0.99)	2.50	0.28	-0.54
Behavioral component				
Intention of Use	3.08 (1.03)	3.17	-0.36	-0.71

Keeping in mind that the scale ranged from 1 (fully agree) to 5 (do not agree at all), the descriptive analysis revealed that ratings for attitude dimensions are low to medium. Consequently, students had a rather neutral attitude towards the use of video-based media in physical education. Access to media in physical education had a particularly large standard deviation, indicating that lessons vary greatly in terms of the use of media. The negative kurtosis revealed that rather platykurtic or flat-top distribution with a tendency towards less extreme values.

Model Validation

The postulated model showed an acceptable fit of the data regarding the absolute fit (RMSEA = .06) and the parsimonious fit (χ^2/df ratio = 1.72). With regard to the incremental fit, the CFI was slightly below the criteria (CFI = 0.895) but overall fit of the data could be assumed. To ensure readability, only significant paths

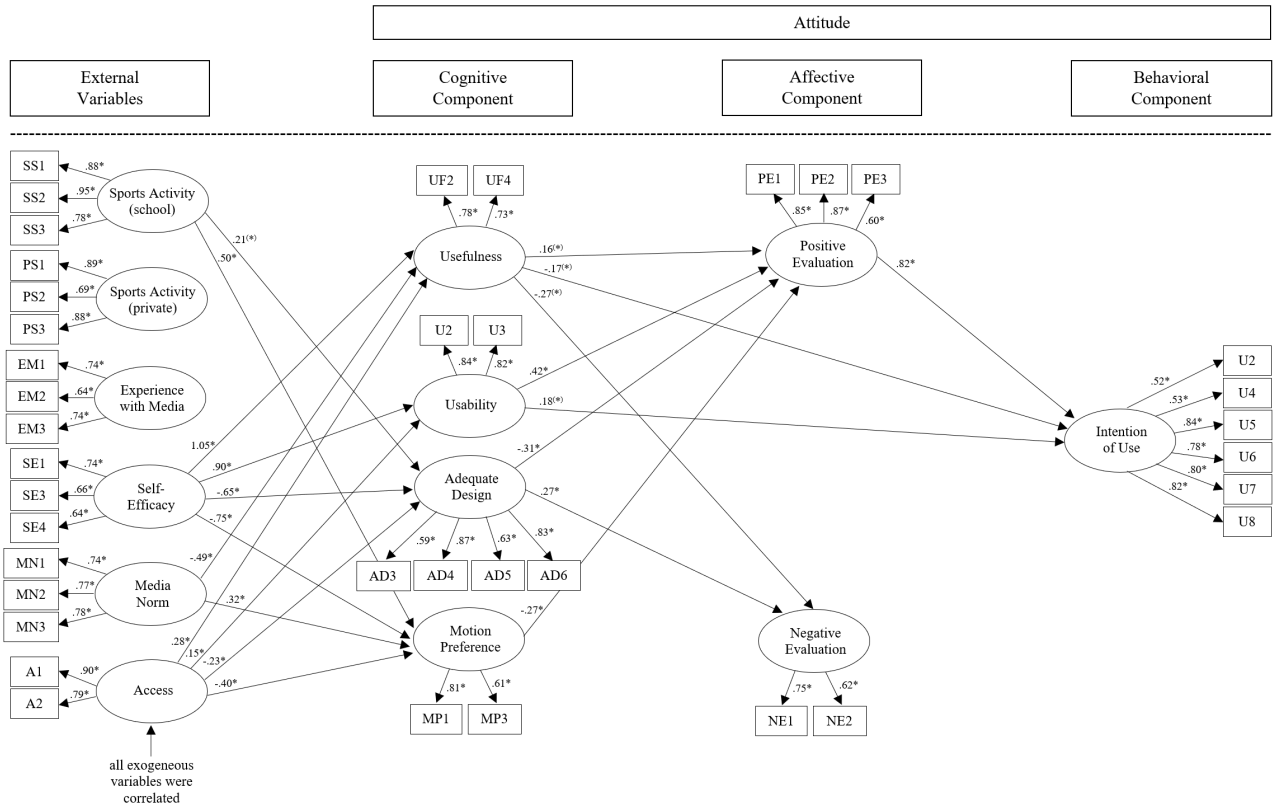

Figure 3 *Attitudes of students towards the use of video-based media in physical education (conducted model), β values are displayed, * p < .05, (*) p < .10, to ensure readability error terms are excluded.*

(p < .05) or at least descriptive trends (p < .10) are displayed. A complete overview of all paths is displayed in Appendix B. The model is presented in Figure 3.

Results revealed that access as well as self-efficacy in learning with video-based media fostered perceived usefulness (access: β = .28, p = .002; self-efficacy: β = 1.05, p < .001), as well as perceived usability (access: β = .15, p = .04; self-efficacy: β = .90, p < .001). Additionally, both external variables reduced concerns regarding adequate design (access: β = -.23, p = .006; self-efficacy: β = -.65, p < .001) and motion primacy (access: β = -.40, p < .001; self-efficacy: β = -.75, p < .001). Interestingly, higher scores in media norm reduced perceived usefulness (β = -.49, p = .002) and enhanced concerns regarding motion primacy (β = .50, p < .001). A higher school related sports activity further enhanced concerns regarding the motion primacy (β = .32, p = .03). Results further outlined that sub-constructs of the cognitive component of the attitude did not directly affect the intention of use video-based media in physical education since only descriptive trends were found. On the contrary, it could be shown that effects of the cognitive component on the behavioral component are mediated through the affective component. A higher perceived usability is associated with a positive evaluation (β = .42, p = .03). Furthermore, lower concerns regarding an adequate design (β = -.31, p < .001) as well as the motion primacy (β = .27, p < .001) enhanced positive evaluation of media use. A higher positive evaluation is further associated with a higher intention of use video-based media in physical education (β = .82, p < .001).

Discussion and Conclusions

Answering and Discussing Research Questions

To answer RQ1 "What is the actual expression of attitudes towards the use of video-based media in physical education", descriptive data from Table 1 was evaluated. At first glance, students have a neutral to negative attitude towards video-based media use in physical education. Students perceive the video-based media not generally as useful as well as usable. Students reported concerns regarding the design of the video-based media as well as the motion primacy. Consequently, the current investigation supported findings that outlined that students do not generally have a positive attitude towards media use in physical education (Jones et al., 2010; Schulmeister, 2009). Furthermore, the current investigation extended prior findings by outlining that a differentiated view must be taken of the cognitive component, since physical education didactic specifics have an additional influence on the related attitude. This also becomes clear when looking at the affective component. Data regarding the positive evaluation give rise to a rather neutral to negative affective attitude about the attitudes in terms of media use. Furthermore, there is evidence that students have reason to evaluate video-based media use negatively since low to medium scores can be observed for "negative evaluation". Again, this supports prior findings outlining that students did not have positive attitudes for media use in education in general (Jones et al., 2010; Schulmeister, 2009). Finally, scores regarding the behavioral component revealed a medium score as well. The rather neutral ratings outline that students have no particular desire to use video-based media in physical education. To consider potential explanations, results regarding RQ2 and RQ3 are discussed.

Considering RQ2, external variables that might influence the emergence and adherence of attitude were investigated. In line with H3 and H4, prior access to video-based media in physical education and an associated self-efficacy fostered a positive attitude regarding the cognitive facet. As prior research showed (e.g. Howard et al., 2016; Petko et al., 2018), the mere use of video-based media can positively influence students' attitudes towards video-based media. Another explanation can be derived from the contact hypothesis. Based on the work by Allport regarding racial prejudice(Allport, 1954), confrontation with people can reduce prejudice if certain circumstances are met. Keeping this in mind, confrontation with the processes and benefits of media-based instruction can thus, put erroneous assumptions and negative attitudes into perspective and ultimately reduce them (Schiappa et al., 2005). Recent results outlined that the contact hypothesis is not restricted to humans-to-human interaction (e.g. Gou et al., 2021) and this study provides further evidence. H1 and H2 could not be supported. Interestingly, a higher media norm as well as a higher private sports activity had negative impacts on the cognitive component of the attitude. Potential explanations could be derived considering that more experienced sports students are used to current instructional techniques and are sceptical of innovations. In addition, these findings could also be due to students', like teachers', fears of sports activities being displaced by media activities (Roth, 2022). In contrast, it might be possible to win over inexperienced students by using video-based media. Furthermore, students who believe that video-based media are important and suitable for instructional purposes, might be more aware that this also entails problems regarding the design and thus, the usefulness.

With regard to RQ3, relationships between the components were investigated. H5 could not be supported since only descriptive trends could be observed. H6 to 8 could be partially supported. A higher perceived usability, as well as lower concerns regarding the design and the motion preference fostered the positive evaluation of the attitude but no direct effect on the intention of use can be shown. Consequently, making students aware of the possibilities and reducing assumptions that video-based media in physical education can lead to undesirable effects, led to a positive affective reaction towards media use. This is a further indicator for the contact hypothesis. Considering the effects on the affective component is not only a "by-

product" or symptom of cognitive change, it is of crucial importance. The effects of the cognitive sub-variables on the intention of use seemed to be mediated by the affective component, more precisely: the positive evaluation. Positive evaluation of media use was the crucial factor that positively influenced the intention of use. This further emphasised the importance of the affective component (Rosenberg & Hovland, 1960) as already shown in prior TAM research (e.g. Park, 2009). Consequently, H9 can be supported partially, since this effect could be shown for positive evaluation but not for negative evaluation.

Overall, the current study outlined a valid model to assess the attitude towards the use video-based media in physical education. Furthermore, the model specified external variables that had major influence on the expression of the attitude. Summarizing the core findings of the model, the access to video-based media and thus, gaining the self-efficacy in learning with video-based media fostered a positive attitude with regard to the cognitive component (e.g., usability and usefulness). High scores on the cognitive component did not foster the intention to use in general. The effect was mediated through the positive evaluation which outlined the importance of affective processes on behavioral intentions.

Implications

On theoretical side, the results can encourage to initiate intervention studies. As discussed, media use, particularly video feedback has great instructional potential for motor learning in physical education (Mödinger et al., 2021) . In addition, the attitudes of students towards the use of video-based media in physical education should be focused on as a relevant target perspective, as from the knowledge of students' attitudes and their genesis, consequences for the didactic staging of the use of video-based media in physical education can be derived. Up to now, the use of video-based media in physical education has been dominated by motor learning objectives and positive media-related attitudes of students are often naively assumed. In this context, however, the findings indicate that contact with video-based media in physical education alone has a positive effect on students' media-related attitudes, even if these are primarily used with the aim of triggering motor learning processes. There are similarities here with the factors discussed on the basis of the findings on pupils' general attitudes towards PE lessons (Digelidis et al., 2003; Potdevin et al., 2018; Sigrist et al., 2012). Nevertheless, research could focus on how to reduce negative attitudes so that potentials can unfold through increased usage behavior. Since the results of the current study support the contact hypothesis, further theoretical insights are needed on how exactly video-based media can be introduced to students to best promote positive attitudes.

Despite the dynamic dissemination in the lives of young people, digital technologies have so far been underrepresented in the school context; in addition, teachers are sometimes ambivalent about the use of digital media and technologies (Blume, 2020; Roth, 2022) and do not fully exploit their potential (Greve et al., 2022; Lorenz et al., 2021). In addition to motivational and infrastructural reasons, the low level of digitization-related professional knowledge of teachers is discussed as a reason for this (Petko, 2012; Sousa, 2018; Van Hilvoorde & Koekoek, 2018).On practical side, teachers should be encouraged to use video-based media in physical education. The increases in media use in all areas of society and, in particular, the increased media usage times of children and young people (Rideout & Robb, 2020) must not be equated with a fundamentally positive attitude toward media use. Even if holistic media literacy models take into account multiple facets of competence, an instrumental-technical facet often dominates in physical education practice, leaving attitudes of the actors involved unconsidered. A targeted examination of media-related attitudes offers opportunities to fundamentally change media-related learning prerequisites and to enable learning processes that might be hindered by negative attitudes. Physical education promotes reflection on body image, considering both internal and external perspectives, and supports differentiation and personalized instruction for diversity-sensitive

teaching. In this context, video feedback offers significant opportunities to explore these aspects, providing reflective possibilities that extend beyond merely correcting motor errors.

In order to unfold the potential of video-based media, self-efficacy of students concerning learning with media should be fostered. This is also relevant under the aspect that correlations between social status and media use behavior of children and adolescents in Germany have been shown (Shell, 2019) and school could ensure equal access opportunities here. To do this, students must have access to video-based media and gain compelling experience in the instructional context. In order to ensure the didactically adequate use of video-based media in physical education, teachers should, of course, be appropriately trained to be able to deal with both the technology and the pedagogical challenge.

Limitations and Future Research

Two methodological limitations have to be discussed. Initially, the negative evaluation scale exhibited relatively low reliability. This factor could potentially contribute to the absence of a discernible link between negative evaluation and intention of use. Second, we measured all components and constructs with a single questionnaire without time delay or a comparable method. Consequently, a causal interpretation of the paths is not possible. Thus, the results show clear associations between the sub-constructs, but to show causal effects, future studies will need to employ elaborate methodological procedures. For example. experimental variations of external variables might give further insights into causal effects of these variables on the attitudes towards video-based media use in physical education. Furthermore, longitudinal studies could give additional insights in how these attitudes change over time and if they are rather stable or more easily influenced through interventions.

On the level of media didactic concepts for physical education, there is also still a strong need for research and development, since beyond the discussed training science findings on movement learning with video feedback, good practice examples and recommendations for action have dominated in the subject of physical education so far, which lack empirical foundation. In addition, negative attitudes of physical education teachers towards the use of video-based media in physical education represent a challenge for teacher training and continuing education that needs to be systematically addressed. Further, it might be relevant to analyse if teachers' attitudes and the resulting media use in educational settings might also influence the attitudes of their students. Finally, intervention studies should be in the focus of research. As we discussed, media-related attitudes might be a key factor for the effectiveness of digital media in education. Thus, interventions should be developed and evaluated that foster positive attitudes particularly in physical education.

Conclusions

To sum up, a valid model has been developed which suggests that access and self-efficacy are key factors in understanding the merging of positive and negative attitudes towards the use of video-based media in physical education. Furthermore, positive perceptions in terms of the cognitive component of attitude are not sufficient to promote intention to use. Students also need to experience positive affect in order to promote behavioural intentions, highlighting the importance of affective processes in understanding the emergence and expression of attitudes.

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Competing interests

The author/s has/have declared that no competing interests exist.

Data availability statement

The dataset generated for this study is available on request to the corresponding author Maik Beege.

Ethics statement

All procedures were performed in full accordance with the ethical guidelines of the German Psychological Society (DGPs, https://www.dgps.de/index.php?id=85) and the APA Ethics code with written informed consent from all subjects. The study received a unanimous positive vote from the ethic committee of the University of Dortmund (Germany) without any conditions in September 2022.

A Appendix

Appendix A: Item formulations and descriptive values

External Variables

Item	Mean (*SD*)	Median	Skewness	Kurtosis
School-related sports activity				
I like Physical Education classes.	4.14 (1.00)	4.00	-0.95	0.28
Physical Education is one of my favorite subjects.	3.89 (1.34)	4.00	-0.81	-0.76
I would rather have no Physical Education in school.	4.42 (0.98)	5.00	-1.77	2.46
Private sports activity				
I do a lot of sports outside of school.	4.04 (1.14)	4.00	-1.08	0.28
I am not interested in sports in my private life.	4.26 (1.16)	5.00	-1.47	1.05
I enjoy doing sports outside of school.	4.24 (1.05)	5.00	-1.30	0.92
Experience with media use				

I know a lot about videos.	3.88 (0.98)	4.00	-0.54	-0.29
I don't watch videos.	4.31 (1.04)	5.00	-1.60	1.95
I have little experience with videos.	4.09 (1.08)	4.00	-1.07	0.38
Self-efficacy in media use				
I am confident that I can learn well with videos.	3.66 (0.98)	4.00	-0.50	0.06
I have the skills to learn with videos.	3.69 (0.99)	4.00	-0.50	-0.03
I often don't get important things in videos.	3.64 (1,11)	4.00	-0.63	-0.36
Media norm				
To prepare for my future life, I need to be able to learn well with videos.	3.04 (0.99)	3.00	0.12	-0.20
Learning with videos is important for me.	2.87 (1.06)	3.00	0.17	-0.54
Learning with videos is something that will be significant for me later.	2.70 (1.01)	3.00	0.41	-0.11
Access to media				
We are already watching videos in Physical Education class.	2.10 (1.22)	2.00	0.88	-0.26
We haven't used videos in Physical Education class yet.	2.75 (1.63)	2.00	0.23	-1.60

Cognitive Component

Item	**Mean (*SD*)**	**Median**	**Skewness**	**Kurtosis**
Usefulness				
Videos will improve learning in Physical Education classes.	3.69 (1.00)	4.00	-0.43	-0.35
The content of Physical Education classes is unsuitable for video-based teaching.	3.82 (1.00)	4.00	-0.57	-0.34
Usability				

It's easy to learn how to use videos in Physical Education.	3.22 (1.03)	3.00	0.003	-0.47
The use of videos in physical education is complicated.	3.25 (1.12)	3.00	-0.16	-0.67
Adequate design				
I see the most important things better when someone shows them to me than when I watch a video.	3.45 (1.12)	3.00	-0.19	-0.70
I would rather be taught sports by real teachers than by videos.	3.51 (1.13)	3.00	-0.16	-0.87
I think videos are just as good as teachers in providing knowledge in sports.	3.09 (1.11)	3.00	-0.17	-0.45
Teachers can convey information in physical education much better than videos.	3.62 (0.97)	3.00	-0.09	-0.59
Motion preference				
When we use videos in gym class there is less time for me to move.	3.31 (1.17)	3.00	-0.22	-0.83
I exercise less when I watch videos in gym class.	2.91 (1.28)	3.00	0.10	-1.06

Affective Component

Item	Mean (*SD*)	Median	Skewness	Kurtosis
Positive evaluation				
I think it's good that videos are used in Physical Education.	3.21 (1.21)	3.00	-0.21	-0.83
Learning things about sports with a video is a good idea.	3.41 (1.17)	3.00	-0.30	-0.66
I don't see anything positive about videos in Physical Education.	3.53 (1.17)	4.00	-0.54	-0.51
Negative evaluation				
I don't think videos in Physical Education are bad in general.	2.55 (1.18)	2.00	0.46	-0.55
The use of videos in Physical Education does not cause any particular dislike in me	2.42 (1.12)	2.00	0.35	-0.65

Behavioral Component

Item	Mean (*SD*)	Median	Skewness	Kurtosis
Intention of use				
I would like to know more about videos in Physical Education.	2.91 (1.31)	3.00	0.05	-1.12
I wonder why I should continue to engage with videos in Physical Education.	3.08 (1.32)	3.00	-0.05	-1.09
I would like to see more videos in Physical Education class.	3.07 (1.32)	3.00	-0.13	-1.07
In the next Physical Education lesson, I would like to see a video.	2.84 (1.32)	3.00	0.09	-1.10
My teacher should not use videos in Physical Education.	3.26 (1.31)	3.00	-0.31	-1.03
I don't want videos to be used in Physical Education.	3.34 (1.41)	3.00	-0.32	-1.19

Appendix B: SEM Estimates and p-values

path	standardized estimate (β)	p-value
paths between latent variables		
school related sports activity à usefullness	.03	.82
school related sports activity à usability	.10	.30
school related sports activity à adequate design	.21	.054
school related sports activity à motion primacy	.50	< .001
private sports activity à usefullness	.10	.39
private sports activity à usability	-.10	.31
private sports activity à adequate design	-.07	.49
private sports activity à motion primacy	-.13	.27
experience with media use à usefullness	.07	.49
experience with media use à usability	-.04	.67
experience with media use à adequate design	.07	.47
experience with media use à motion primacy	-.06	.58
self-efficacy à usefullness	1.05	< .001
self-efficacy à usability	.90	< .001
self-efficacy à adequate design	-.65	< .001
self-efficacy à motion primacy	-.75	< .001
media norm à usefullness	-.49	.002
media norm à usability	-.09	.50

media norm à adequate design	.12	.39
media norm à motion primacy	.32	.03
access à usefullness	.28	.002
access à usability	.15	.04
access à adequate design	-.23	.006
access à motion primacy	-.40	< .001
usefullness à positive evaluation	.16	.06
usefullness à negative evaluation	-.27	.054
usefullness à intention of use	-.17	.05
usability à positive evaluation	.42	< .001
usability à negative evaluation	-.17	.18
usability à intention of use	.18	.08
adequate design à positive evaluation	-.31	< .001
adequate design à negative evaluation	.27	.01
adequate design à intention of use	-.09	.26
motion primacy à positive evaluation	-.27	< .001
motion primacy à negative evaluation	.14	.19
motion primacy à intention of use	-.01	.89
positive evaluation à intention of use	.82	< .001
negative evaluation à intention of use	-.05	.51
paths between latent and manifest variables		
school related sports activity à SS1	.88	< .001
school related sports activity à SS2	.95	< .001
school related sports activity à SS3	.78	< .001
private sports activity à PS1	.89	< .001
private sports activity à PS2	.69	< .001
private sports activity à PS3	.88	< .001
experience with media use à EM1	.74	< .001
experience with media use à EM2	.64	< .001
experience with media use à EM3	.74	< .001
self-efficacy à SE1	.74	< .001
self-efficacy à SE3	.66	< .001
self-efficacy à SE4	.64	< .001
media norm à MN1	.74	< .001
media norm à MN2	.77	< .001
media norm à MN3	.78	< .001
access à A1	.90	< .001
access à A2	.79	< .001
usefullness à UF2	.78	< .001
usefullness à UF4	.73	< .001

usability à U2	.84	< .001
usability à U3	.82	< .001
adequate design à AD3	.59	< .001
adequate design à AD4	.87	< .001
adequate design à AD5	.63	< .001
adequate design à AD6	.83	< .001
motion primacy à MP1	.81	< .001
motion primacy à MP3	.61	< .001
positive evaluation à PE1	.85	< .001
positive evaluation à PE2	.87	< .001
positive evaluation à PE3	.60	< .001
negative evaluation à NE1	.75	< .001
negative evaluation à NE2	.62	< .001
intention of use à IU2	.52	< .001
intention of use à IU4	.53	< .001
intention of use à IU5	.84	< .001
intention of use à IU6	.78	< .001
intention of use à IU7	.80	< .001
intention of use à IU8	.82	< .001

variables	**covariance**	**p-value**
school related sports activity <-> private sports activity	.44	< .001
school related sports activity <-> experience with media use	.10	.046
school related sports activity <-> self-efficacy	.06	.19
school related sports activity <-> media norm	-.01	.84
school related sports activity <-> access	-.11	.18
private sports activity <-> experience with media use	.07	.27
private sports activity <-> self-efficacy	.01	.89
private sports activity <-> media norm	-.03	.60
private sports activity <-> access	.22	.03
experience with media use <-> self-efficacy	.25	< .001
experience with media use <-> media norm	.25	< .001
experience with media use <-> access	-.10	.28
self-efficacy <-> media norm	.41	< .001
self-efficacy <-> access	-.03	.69
media norm <-> access	.03	.75