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Aligning Digital Video Technology with Game Pedagogy in Physical Education

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There is a growing interest among physical educators relative to incorporating digital technology in their teaching (Juniu, 2011; Pyle & Esslinger, 2014; Thomas & Stratton, 2006). In part, this willingness is a consequence of digital technology's already formidable impact on how children (and adults!) today experience games, sports and other physical activities. The use of smartphones, tablets, applications (apps), video feedback, serious (educational) games (Michael & Chen, 2006), and YouTube has contributed greatly to these developments. Student learning, teachers' daily instructional practices, and preservice preparation programs are all affected by the ever-increasing sophistication of technology tools. Digital technologies influence how children and youth come in contact with sport, how they shape their own "sport identity" (Pot, Schenk, & Van Hilvoorde, 2014), how they acquire movement skills, and how they perceive and evaluate their movement skill on video recordings (Palao, Hastie, Cruz, & Ortega, 2015). The use of digital technology in physical education differs fundamentally from its use in other school subjects. This is because the learning process in the psychomotor domain is directly observable and public (i.e., it is visible to both peers and the teacher). Thus digital technology can be utilized to help bring the learning process to life for the learner (Casey & Jones, 2011). However, what remains unclear is how, when and by whom technological apps such as digital video analysis could best be used.

This article is directed to physical education professionals, physical education teacher education (PETE) faculty, and sport pedagogy researchers alike, and it will focus on how digital technology can be used to develop students' awareness of tactics in game-based lessons. For example, teachers can use video-based feedback to enrich the way they teach game pedagogy. In particular, the analysis of video footage showing tactical aspects of the game may foster higher levels of insightful tactical play and greater participation by students (Harvey & Gittins, 2014). This "video-edited game analysis" is a typical feature of post-game performance evaluations in competitive sport. However, in the physical education teaching context, where time is a precious commodity, video-based feedback is not very commonplace due to the time needed to set up the multiple pieces of equipment (Tearle & Golder, 2008). Despite its potential, these and other logistical barriers may make teachers less receptive toward the use of technological resources (Pyle & Esslinger, 2014).

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Moreover, students' tactical learning may be facilitated by giving them a video analysis assignment as homework. One caveat is that such assignments require even more time (e.g., video editing) to prepare the assignment. The actual use of video analysis requires that the perceived practical limitations are solved (e.g., short preparation and editing times to produce appropriate video clips) and organizational questions are answered (e.g., which camera and software are needed, how to make the clips instantaneously accessible for instruction, how to minimize the class time needed for its use, which steps to take in applying the video clips in practice with students). When teachers recognize the ease of use and how it genuinely benefits student learning, it will become more likely that they will want to employ new technologies (Tannehill, van der Mars, & MacPhail, 2015).

One important requirement for digital technology to be integrated seamlessly within game-based physical education lessons is that the video recordings related to the intended learning focus are immediately accessible. To accomplish this, a process called "tagging" is available. Tagging refers to marking relevant events in the video recordings in "real time" as opposed to technologies where key events are selected "offline," after the recording has been completed (i.e., after the class is over). Tagging thus provides the teacher immediate access to the video footage that is deemed relevant to share with students. Students themselves can also use the tagging feature to select key events during the playing of the game. This may help support the development of the students' ability to recognize key events in a game, and it provides the opportunity to introduce other didactical tools such as "debate of ideas" and self-regulation (Koekoek & Walinga, 2014). Since most teachers have to split their attention among different situations and different groups of students, providing students with a focused tagging assignment affords them the opportunity to work independently during the lesson (i.e., without direct supervision).

The functions and features of video analysis apps are not always immediately appropriate for the physical education context. Therefore, digital video technology should be adjusted to the demands of physical educators' pedagogy (Weir & Connor, 2009). This article will describe the process of innovating, introducing and developing a digital tagging application to develop students' tactical awareness in playing sport games. Additionally, it will describe how physical educators can be supported in adopting digital video technology during physical education class. Some physical educators may be quite tech savvy and see technology's value and potential. However, not every physical educator can be expected to adopt innovative technology prima facie and become an "early adopter" (cf. Rogers, 2003). The adoption and integration of digital technology can be successful only if it is fused with teachers' pedagogical aims and didactic know-how. Important for physical educators' acceptance and use of technology is knowing how to navigate the technological possibilities. Specific to game-based approaches (GBAs) to teaching sport games, physical education's digitization thus raises several practical and research questions. How, for example, can the use of digital instruction and analytical video technology:

- Impact students' game play performance?
- Aid teachers in their teaching and curriculum/program design and organization?
- Help students analyze their own movement performance on video?
- Help select and show the better performance examples to learners?
- Influence different types of feedback to be used?
- Help develop tactical game-play performance (e.g., better decision-making and tactical moves)?
- Help develop learner autonomy and self-management?

With the increasing expectation that physical educators should infuse technology in their daily work, their professional input is crucial (National Association for Sport and Physical Education [NASPE], 2008). Certainly, not every technological innovation is necessarily suitable for or applicable to the physical educators' workplace context. Moreover, thoughtless use thereof may well take away from students' learning opportunities by reducing physical activity time and/or practice opportunities. Rather, the key to using the right digital technology in the right way and at the right time is for physical educators to be more than just facilitators of learning. That is, they should be deliberate and parsimonious when considering the "which," "why" and "how" of digital technology. Successful innovation depends on the integration of technological, pedagogical and content knowledge (TPACK; Koehler & Mishra, 2009). Based on the work of Shulman (1987), TPACK reflects the integration of subject-specific pedagogical content knowledge (PCK) and technological knowledge (TK), with the latter being the new knowledge domain. This TPACK can emerge only when teachers can fuse (meld) these three knowledge domains. An important goal of TPACK is to challenge teacher preparation programs and sport pedagogy researchers to consider the role of teachers' practical knowledge and how they use that when deciding whether, in what way, and in what instances to use specific technologies in their lessons (Koehler & Mishra, 2009).

Frameworks for the Role of Technology in Game-based Approaches

Today, physical educators who employ GBAs to teaching sport games (e.g., teaching games for understanding [TGFU], play practice) can draw on an emerging evidence base that also has support in the motor learning literature (Chow et al., 2007; Davids, Button, & Bennett, 2008; Tan, Chow, & Davids, 2012). Before discussing the potential of digital technology within GBAs, it is important to highlight one of its central features: its focus on having learners develop better decision-making skills during actual game play (e.g., Bunker & Thorpe, 1986; Griffin, Brooker, & Patton, 2005; Kirk & MacPhail, 2002; Koekoek, Walinga, & Dokman, 2009; Launder & Piltz, 2013). For example, a basketball player must choose whether to shoot, pass to a teammate, drive to the basket, or continue to dribble to maintain ball possession; tennis players must decide which shot to use and where to place the shot given the context at that moment; baserunners in softball must determine whether or not to take the extra base. Decision-making lies at the heart of every action players take in game play and, thus, should be a central focus of the teaching-learning process within game contexts (e.g., Light, Harvey, & Mouchet, 2014). This perspective is also supported by current theoretical frameworks about learning to play and practice (Chow et al., 2007; Gréhaigne, Godbout, & Bouthier, 2001; Harvey & Jarrett, 2014).

Digital Video-based Analysis for Developing Tactical Decision-making

One of the key principles of GBAs is that teachers create game conditions that are developmentally appropriate through deliberate game modifications for the number of players, field/court dimensions and equipment, player restrictions, scoring rules, and so forth. Its central purpose is to help students develop better insight into the tactical aspects of the game, together with learning to execute the techniques (i.e., controlling the object such as a ball or a shuttle), also referred to as "game sense" (e.g., Launder & Piltz, 2013; Light, 2013). Students' game sense emerges when they start coming up with better solutions to the two main questions: (1) What should I do? and (2) How do I do it? (Bunker & Thorpe, 1986; Griffin & Patton, 2005). There is evidence that the learners' perceptions, conceptions of game play, fondness (or "liking") of the activity, and social interactions influence the solutions they devise (e.g., Light, 2006; Koekoek & Knoppers, 2015; Pope, 2005). Thus, since learning to make better decisions during (modified) game play is a complex process, it should be primarily student-driven rather than teacher-driven. This does not diminish the role of the teacher in any way, who must still design the right modified game contexts with a clear purpose (what Launder and Piltz [2013] refer to as "shaping play"), and monitor how students respond to that specific game context. Within that context, individual students (but also the teammates) learn through self-organization based on the actions of teammates and opponents (Richardson, Sheehy, & Hopper, 2013).

A form of game analysis that can complement and support the pedagogy of tactical decision-making is for players to be able to view their own and others' game-play actions on digital video (e.g., Harvey & Gittins, 2014). Game video review has long been an integral part of preparation for subsequent games at the higher level of sport competition (e.g., high school, college and professional sport teams). Video review can also help teachers who seek to develop students' game sense, and it can support teachers' verbal instructions. By watching short videos together with teammates and conducting brief discussions around the tactical decisions made, students' decision-making can be made more explicit and meaningful. Therefore, teachers can use the "debate of ideas" dialogue (Gréhaigne, Richard, & Griffin, 2005) for developing students' tactical understanding (e.g., Storey & Butler, 2010). The debate of ideas approach can be best viewed as a group discussion in which perspectives and opinions from players and the teacher are interchanged. This exchange can lead to new insights for students, thereby improving their tactical knowledge and awareness and increasing their versatility as players.

Before teachers introduce a debate setting and combine this with digital tagging assignments, players need time to get used to the game. The learning process starts with playing the (modified) game, where students get the opportunity to explore the tactical possibilities and demands presented by the teacher. Students need time to get used to the rules, their teammates, and the aim of different playing roles in the game. After a few matches of at least 5–10 minutes each (and usually during a timeout or in between two matches), the teacher starts facilitating the group discussion between the observers (i.e., non-playing students) and players through open-ended tactics-focused questions (e.g., Harvey & Light, 2015). Such a group discussion could last up to five minutes, depending on the students' attention capacity. The intended goal is for a team to develop a consensus on possible solutions to

the tactical problem presented in the game. The debate of ideas is a didactic tool that can be supported by digital tagging procedures and digital video analysis. Teachers are able to connect students' perceptions about game-play performance to the intended learning focus of the game through the use of the right questions and prompts (e.g., Harvey & Light, 2015). By using video-game footage teachers also can better align and focus the attention of students (Ste-Marie et al., 2012). Moreover, through video playback students can see themselves and others perform, even without the teacher verbally sharing his or her intention.

Real-time Tagging of Game Play as a Learning Tool

Table 1 includes a series of steps and accompanying questions for teachers to consider when assisting students in learning to tag tactical situations while playing invasion games, such as basketball or soccer.

In step 1 teachers design a game form that includes contextual modifications (e.g., equipment, team size, play space, rules, scoring) that are appropriate for the lesson's objectives and that allow players to practice the designated tactical moves (Koekoek, Dokman, & Walinga, 2014). For example, a basketball game (3 vs. 3) on a half court supports the offensive players to learn when to try to score or to pass, and for off-the-ball players to take position in the court in order to receive the ball during offensive play. When it appears that players have difficulties deciding when to try to score on the basket, the teacher can modify the game into a power-play situation (3 vs. 2) to give the attacking team more passing choices and scoring opportunities. Such a modification is deliberate, as it intends to create an imbalance between the offensive and defensive teams (Travassos, Vilar, Araújo, & McGarry, 2014).

In step 2 the teacher creates a rubric or guideline to define the goals and key events. Based on his or her observations of game play, a learning objective moves students forward in their development as skillful players. In the basketball example players in the offensive role may learn when and how to pass the ball to teammates when they find free space and/or take a position near the basket. Based on how the students respond in the game, teachers can then make further adjustments in the game's design (what Launder and Piltz [2013] refer to as "refining play"), thereby creating more authentic learning conditions. That is, the learning process can be focused on students' decision-making and their tactical play opportunities (Koekoek, Dokman, et al., 2014).

In steps 3, 4 and 5 "tagging" takes on a prominent role. The modified game is video recorded, and key events are tagged in real time and are thus immediately available for analysis by the teacher. Not only the teacher, but also one or two students can take the role of observer (tagger) while 8–10 students are playing. The games consist of a maximum of eight players (e.g., 4 vs. 4) in order to achieve optimal learning and observing opportunities. Especially with students who have never analyzed tactics before, it is important to keep team sizes small. With the number of players in the teams increasing, it is getting more and more difficult for the observer to distinguish different phases and tactics in the game. It is therefore important that teachers are mindful of the following questions: (1) Can students successfully complete assigned tagging tasks? (2) What do students themselves actually observe within

Table 1.
How to Apply Digital Video Analysis in Educational Settings

Step	Didactical Process	Players	Questions to Be Answered	Example in a Modified Soccer Game
1	a. Determine balance of play b. Play the game and make any necessary adjustments to ensure balance of play	Teacher or student observer	Which tag panels on balance of play provide reliable information?*	• The teacher organizes several matches with different circumstances (team compositions, field sizes, adapted rules, etc.). • Matches last at least 5 minutes.
2	Present one or more learning goals within the game	Teacher working with both players and observers	• What learning goals are appropriate for both players and observers? • How can the learning goal(s) be made more explicit through the use of digital media? • What is the students' reaction and receptiveness to the use of video records within the lesson?	The forwards learn to choose their position toward each other (and the defenders) in such a way that they can keep possession of the ball.
3	Propose students a tag-observation task	Student observer	• Which "game events" can students realistically observe and tag when observing the game? • How many unique "game events" can students capture with a tag panel?	Students need to push the button when they see a player taking the right position.

(continued)

Table 1.
(Continued)

Step	Didactical Process	Players	Questions to Be Answered	Example in a Modified Soccer Game
4	Play the game, with observers engaging in tagging	Student players	• What are the students' experiences with tagging a game? • Which device can best support the tagging task? • What are the optimal tag panels for a game in terms of the type and number of events to be tagged? • Which camera set-up works best to capture all game action? • To what extent does varying the camera location add to the quality of the students' tagging?	• The student observer has only one event to tag. • The teacher uses a Wi-Fi action camera that is positioned from above so that the whole field is visible and all the players can be recorded.
5	Compile/collect the tags recorded by student observers	Teacher	• How can student-generated tags be made accessible with ease and in a speedy fashion? • How will tagged game events be organized for subsequent review by the student players? • How can individual students' opinions about the game events result in a commonly agreed-upon tactical plan of action in subsequent game play?	• The student observer shows the tag recordings to the players. • These clips are watched by both the players and the teacher. • With the 'play all' function, all the clips are directly available. • Players of one or both teams watch the clips that lasted 3 minutes.
6	Ask the question: Why did the student observer choose to tag those specific key moments in the game?	Student observer	What types of questions will direct students to focus on the tactical dimensions of play?	The teacher asks the player: Why do you think the observer has tagged these clips in particular?
7	Conduct a time-out to have a "debate of ideas"	Student players, student observer, and teacher	How can the teacher shape/direct the debate of ideas?	• The players give a few responses to the teacher's question. • The teacher facilitates discussions and tries to direct the discussion to one or two plans.
8	Formulate an agreed-upon tactical plan of action for subsequent play	Teacher	How does a team arrive at an agreed-upon plan of action?	The tactical plan for one team or both teams will be presented as a conclusion by the teacher, and the players need to agree.
9	Return to playing the game	Teacher (who could possibly start a new cycle of analysis)	• What did students learn as a result of using digital video analysis? • How would students reflect on having used digital video observation and analysis?	

**The strength of the attack and defense based on scoring percentage with respect to ball possessions (Koekoek, Dokman, & Walinga, 2014).*

the game that they view as pertinent when given a focused tagging task? and (3) What types of tagging tasks are more appropriate, especially in the early stages of learning?

Returning to the basketball game, teachers should consider what the best instruction is for the students in identifying the passing of balls to teammates. Furthermore, the teacher should make sure that the observation assignment corresponds to the students' skill levels — for instance, whether or not they are able to analyze game tactics involving multiple perspectives, such as identifying the roles of offensive and defensive players at the same time. An

appropriate tagging assignment ensures that the teacher's goals are aligned with the students' observation capacities.

Steps 6 to 9 emphasize the process of tactical group discussions with the students in a "debate of ideas" session with video. Teachers need to support the observers in explaining their video tags to the group and moderate the discussion between observers and players. It is important that the presented video clips work as a clue to enhance tactical awareness and the agreement between players in tactical strategies.

Tablet computers equipped with cameras can produce relatively good digital video footage. There are now several examples of simple software (or apps) for game analysis that allow for tagging key game events (i.e., to mark or record) that can be retrieved and watched immediately after recording — for example, the Video Tagger (costs $2.27 in the iTunes App Store; Robinson, 2014) and Dartfish EasyTag (costs $6.45 in the iTunes App Store; Dartfish, 2017). Both apps are compatible with iOS and Android. The Dartfish EasyTag app allows users to develop "tag panels." Tag panels are like a digital keyboard that a user can customize.

For example, tag panels can be created with separate tag buttons for game events such as ball possession, shot attempts, passes or turnovers. When a student who is assigned the role of observer identifies a turnover and hits the corresponding button, a "tag" is registered immediately along with its time of occurrence. This type of information provides insight into the observation and analysis skills of the student. Moreover, it can provide the basis for subsequent assessments and discussions (i.e., "debate of ideas") among students (and teachers) about decisions made by the players (e.g., Koekoek, van Hilvoorde, van der Kamp, & Walinga, 2014). The next section shares some results of students' tagging behavior that have also become the basis for new approaches to game didactics and have provided direction for the development of a new video analysis app.

Perceptions and Tagging Behavior of Students in Basketball

Before attempting to bring together the components of TK and PCK, the authors sought to answer a number of conditional questions related to students' observational capabilities using digital technology: (1) What types of and how many game-play dimensions can students observe simultaneously? (2) How reliable are their observations (i.e., what would be the level of agreement between three student observers when asked to identify the same game-play events?), and (3) How can user-friendliness of the video analysis app be improved?

The research project focused specifically on the perceptions and the tagging actions of 13–14-year-old students during a modified basketball game. Three students were given an observation task and were instructed to "tag" three events (shots, dribbles and rebounds). To this end, a Dartfish tag panel of three buttons was used. Students were asked to watch a game for five minutes and press the appropriate buttons each time one of the three events occurred. The mean percentages of agreement among students in five separate groups are shown in Figure 1.

Taken as a group, the average percentage of agreement for identifying an event was approximately 50%. That is, in almost half of the events students categorized an event (i.e., "tagged") differently than one of their peers. This shows that, when asked to focus on multiple events of game play, students' game observation skills likely lack reliability, at least when they begin with tagging. And although the agreement improved by about 10% when asked to focus on one event only, students still tended to fail capturing key game events. It is also notable that reliability differed between events: Students identified dribbles and rebounds much less frequently than the attempted shots, resulting in lower agreement percentages for dribbles and rebounds. The authors concluded from

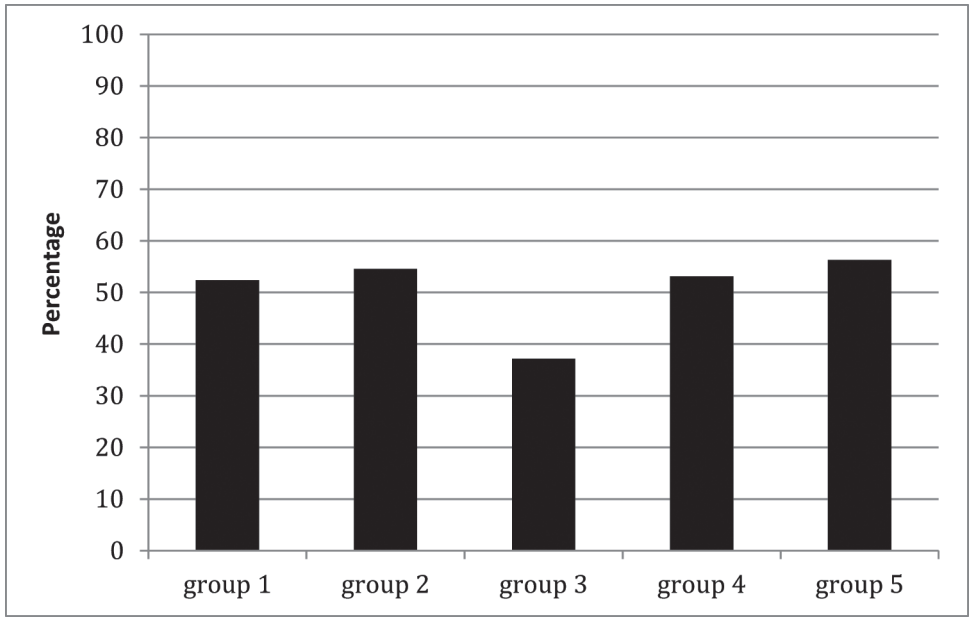

Figure 1.
Student observers' mean agreement percentages on tagged shooting, dribbling, and rebounding events across groups

Figure 2a.
Video-catch opening screen with four tag buttons

Figure 2b.
Setting up the duration and bandwidth of an event that is being stored

this that students need a reasonable amount of time to practice and would benefit from tagging one relatively frequent event only.

While this remains unstudied, the repeated use of tagging tasks (or other observation assignments) during various activities in physical education lessons may well contribute to students' reliability and accuracy in tagging. In addition, dedicated practice in tagging should focus on the dual task aspects of tagging. That is, it should incorporate practicing the motor component (e.g., as in in blind typing, to push the correct button the student must know where the button is without looking) concurrently with watching the game. Another option for teachers is to have student observers work in pairs. This allows the students to separate the motor and watching components. In addition, students can discuss what events to pay attention to and tag.

The pilot study also included interviews with the student observers and players. They were asked whether the use of video-based game analysis added anything to their learning. The students especially valued reviewing the videos, because it helped them to learn from their mistakes. They also indicated that they preferred the teacher to be part of the review together with a small group of peers. The teacher could be the moderator in selecting appropriate images and leading the discussions while watching clips. The authors concluded that students' active engagement in game analysis is a potentially valuable tool. However, teachers need to be mindful of differences in students' observational capacities and ability to recognize key events.

The Technological Development of Video Analysis for the iPad

Some teachers and coaches may already have some experience using game analysis and recognize the capabilities of video analysis applications such as Dartfish EasyTag and Video Tagger. In the aforementioned pilot studies, these digital applications were used and tested to determine their practical application and students' observational capabilities and reliability in the physical education teaching context. These apps showed several limitations in user friendliness for the PE context, such as the amount of time needed to select tagged video clips and accessibility to a clear dashboard, but also the availability of specific features (e.g., drawing, slow-motion play). Based on the insights gained from these pilot projects and with collaboration from a software company, the authors developed Video-Catch, a new video-analysis application (costs $6.45 in the iTunes App Store; AppBakkers BV, 2017). Figure 2a shows the iPad-based opening screen, including four tag buttons.

In using Video-Catch, the user can customize the analysis focus by defining each tag button based on the technical and/or tactical focus of the lesson (e.g., ground strokes, passing, guarding/marking, off-the-ball positioning/movement, support). For each individual tag button, the duration of the footage of the event that is selected and stored can be set in advance within a bandwidth (the number of seconds) before and after the button is pressed (Figure 2b). The game can be recorded using the "record" button, but only the game events captured with the tag buttons are stored. An uncluttered dashboard (Figure 2c) allows for quick retrieval and playback of clips. In play mode users can employ slow motion, can freeze the image, and can use a multi-colored free-hand drawing tool (Figure 2d). In addition to using the iPad camera, Video-Catch can be linked to an action camera (e.g., Sony) using its Wi-Fi signal. With that setup, the signal from the action camera can be picked up by the iPad, and observers can tag key events.

New Knowledge by Merging Technology and Didactics

The use of Video Tagger, Dartfish Easy Tag, and the subsequent development of the Video-Catch app have provided initial insight into how digital video technology can be infused into the physical education context when using GBAs to teach sport games. The didactic game structure supports the construction of a lesson plan, as shown in Figure 3. Didactics in GBAs can be broadly classified

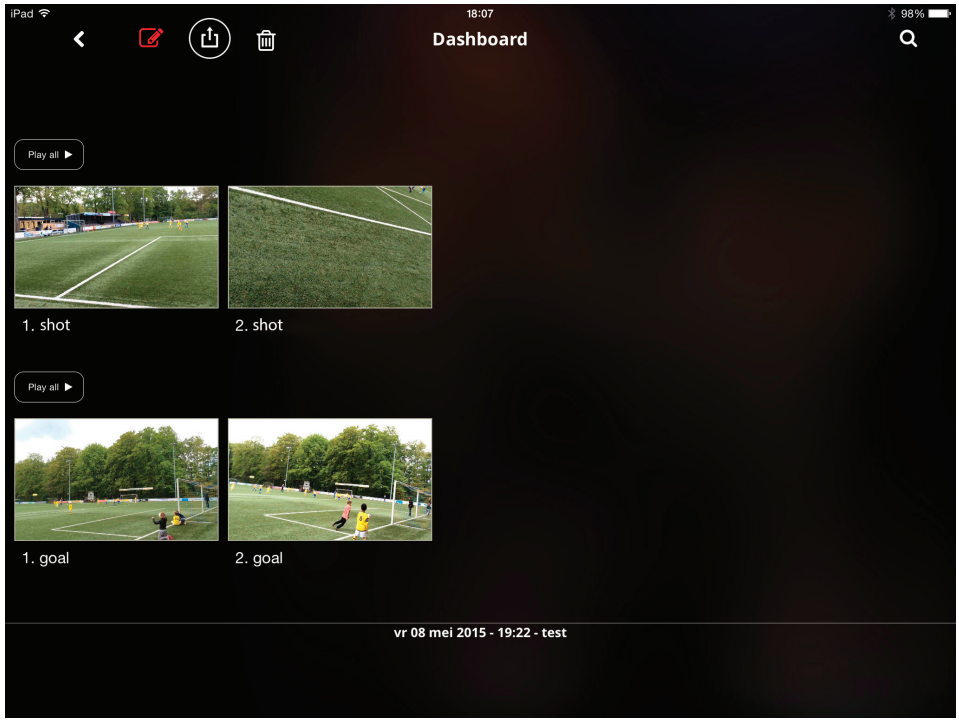

Figure 2c.
Dashboard sorted by tags for quick playback of video clips

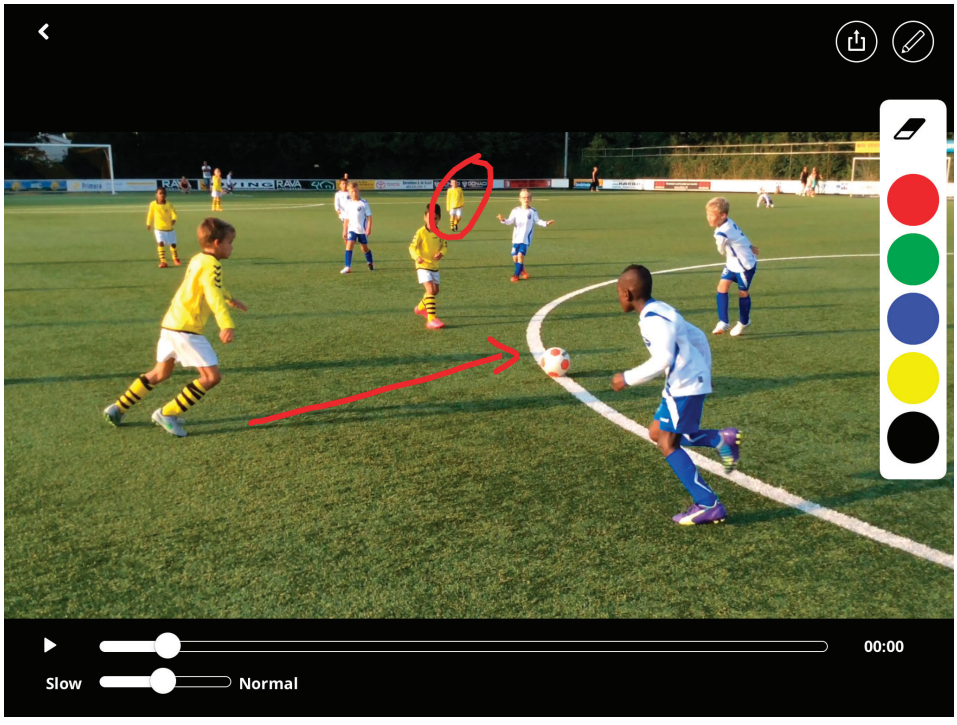

Figure 2d.
A multi-colored "free-hand draw tool"

into three cyclical steps: (1) making direct game adjustments, (2) conducting a "game balance analysis," and (3) providing tactical learning aids. In the first step the teacher presents a game design focused on achieving a balanced team composition, such as field, equipment and rules modifications. Beyond student enjoyment in being able to play, the goal is for the modified game design to be deliberate and directly linked to the goal of the lesson.

A game balance analysis allows the teacher to determine the quality learning of the game by judging how well both teams' offense and defense are in balance (step 2; Koekoek, van der Kamp, Walinga, & van Hilvoorde, 2014). Well-designed games are those with an even balance between the offense and defense. Balanced game-play reflects a learning-rich game design. Conversely, if one of the teams is too dominant, learning opportunities are diminished.

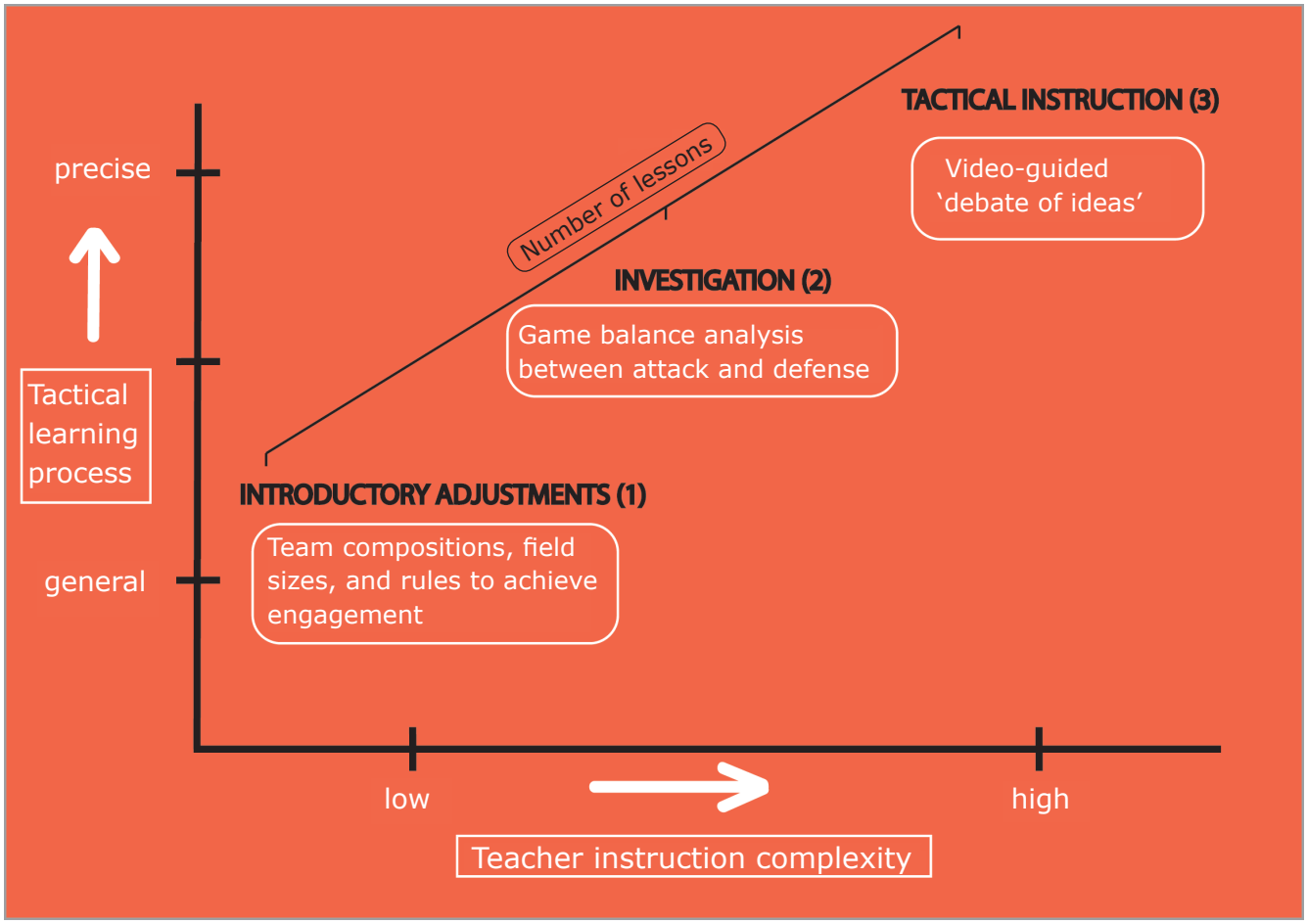

Figure 3. Didactic structure of a lesson plan using video analysis in game-centered teaching

When game scores become too lopsided (i.e., unbalanced offense and defense), the aforementioned step 2 is triggered through further game-design adjustments, as well as the employment of the debate of ideas (i.e., brief question and answer–focused timeouts). The goal for the teacher is to provide learning support to a team or individual students. It is especially here that the use of video analysis can become meaningful to students. From a didactical perspective, infusing a meaningful selection of captured video images within a debate of ideas dialogue among or with students is perhaps also a more complex task for teachers. That is, it requires a seamless interplay between teachers' knowledge (and application) of tactical learning objectives, the use of digital technology, and the collection of relevant images (via instant tagging) directly into the lesson, and then leading focused discussions with the students.

It is important to consider when it would be the right time and place to use digital apps like Video-Catch. The use of this cognitive learning aid is more appropriate later in sport game units when teachers seek to enhance play (see also Launder & Piltz, 2013). At the outset of a sport games unit students start learning about the game by developing a more general idea of the technical and tactical demands of the game (e.g., how to kick, shoot and pass; game rules, tactical problems to be solved). Only after several lessons will it make sense for teachers to employ the third step in the process by introducing the debate of ideas along with meaningful analysis of tagged video images, and to zoom in on the tactical aspects of game play.

It is in this third stage that teachers can support student learning by drawing their attention to specific game actions through the review and replay of captured video segments. The premise here is that providing teaching support on the tactical aspects of the game is easier when students see images of themselves and can reflect on them through brief discussions with their teacher. The captured video footage not only provides tangible feedback on what happened, but also encourages reflection about what is possible in the game tactically. Thus the information garnered from Video-Catch, in combination with the use of the debate of ideas tool, places the teacher in a stronger position to support learning. As part of these brief debate of ideas discussions, the authors recommend that teachers make use of a "praise-prompt-challenge" approach (Koekoek & Walinga, 2014):

A. Giving Praise (Compliments). Recording the game on digital video and tagging key moments of play enables teachers to compliment and reinforce students' actions during game play through positive feedback. The focus should be on reinforcing those actions that enhance the level of game play, rather than some arbitrary and rote form of praise. In particular, lower-skilled (or

inexperienced) students have been shown to benefit from this type of teacher support.

B. Giving Prompts (Suggestions). Beyond merely observing the students' actions during game play, the tagging of key moments in the game is a way of helping teachers to focus on what prompts to use during the subsequent debate of ideas discussions. Teachers can now support their prompt (i.e., suggestion) through a replay of the captured video segment. Video analysis typically is chosen for a message that focuses on the execution of individual techniques (e.g., the execution of a backhand ground stroke in a racquet game). However, it can also be used to highlight students' tactical actions. Thus the key is to balance the technical focus with a focus on the contextual aspects that may influence students' actions (e.g., getting students to see the consequences of inaction or avoiding actions, such as a failure to get back to a central court position in a net-court game or a pitcher not backing up the third baseman on a throw from the outfield).

C. Asking the Right Questions (Support Learning). Apps such as Video-Catch play an important role in framing questions that teachers want students to consider during the debate of ideas and when playing the game. It is here that students can be given ownership by being asked to serve as video taggers (as opposed to the teacher) to capture key moments in the game. These can then be reviewed and discussed within their own teams. This will help individual students and/or a whole team to develop further as players.

Implications for Teachers, PETE Faculty, and Sport Pedagogy Scholars

Tannehill et al. (2015) noted that educators will generally respond differently to new developments on the technology front. Specific to the digital video technology presented in this article, infusing technology into daily instructional practices requires keen insight and decision making to determine the true return on investment. Teachers will need to determine the cost and the time needed to learn to use the tool effectively during instruction. They also need to gauge whether or how the technology features enhance their own instruction and impact students' learning experiences.

Physical education teacher education faculty may require professional development as well in order to effectively make the case for PETE majors to apply this technology and demonstrate the use thereof. Sport pedagogy researchers (especially those whose research focuses on the use of GBAs) should analyze the impact of digital video technology as presented here on student learning, as well as on teachers' instructional processes. Researchers interested in studying the use of such technologies should not only focus on how the combination of these technological and pedagogical innovations can actually foster student learning in game play contexts; they should also focus on developing a greater understanding of the teachers' use of technology in physical education as a central area of inquiry within this area (Mumtaz, 2000).

Conclusion

This article described the process of innovating, introducing and developing a digital tagging application that can be combined with game didactic strategies for teaching tactical awareness in sport games. The development and amalgamation of both offers new insights into the appropriate time and place for using digital technology when using a GBA to teach sport games. Moreover, the technology was customized specifically for use in the PE context. As is the case with many other choices that teachers must make relative to instructional strategies, everyone should decide whether it is justified and useful to employ the digital technology presented here.

The essence of physical education remains to develop skillful movers, first and foremost. Within that context teachers typically instruct through verbal directions and instructions (e.g., prompts, feedback, questioning). The use of tagged video images that are immediately accessible can help students as they confront their own (and their teammates') actions in the immediate game context. The move toward incorporating digital video technology into GBAs within physical education is still in its infancy. However, the rich potential of technologies such as Video-Catch in supporting the development of skillful play among students deserves further exploration, experimentation and study.

New digital technologies will undoubtedly continue to emerge, and technology will likely continue to make further inroads into (physical) education. Thus it may not be too far off to envision physical educators providing an iPad to each team in class with software such as Video-Catch already loaded. Moreover, students themselves will no doubt come to school with greater knowledge in how to use electronic tablets and the like. Especially in the case of sport education, students are afforded the opportunity to spend more time learning a sport activity, and they are expected to be more self-directed (Siedentop, Hastie, & van der Mars, 2011). Teachers might choose to dedicate class time to present a module on the use of the digital technology and the tagging process aimed at supporting game-play development. Sinelnikov (2012) already pointed to the potential value of using iPads in the context of sport education in support of learning to fulfill the various non-playing roles (e.g., coach, manager, statistician). The use of digital technology, along with tagging, constitutes a natural extension that can potentially support the development of competent players.

For more specific information (i.e., manual) about the Video-Catch software, please contact the lead author.

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