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Inquiry-Based Learning Approach in Physical Education:

Stimulating and Engaging Students in Physical and Cognitive Learning

Lars Domino Østergaard

Teaching and learning in physical education (PE) is not just about introducing students to different physical activities. Neither is it only about practicing skills related to selected sports such as soccer, basketball or volleyball, or about learning "about, through and in movement" (Arnold, 1979; Whitehead, 2013). According to Capel and Whitehead (2013), the key role of PE is to foster the development of cognitive and physical competencies to provide individuals with the confidence and motivation to continue the physical activities outside of school and feel well equipped to sustain or gain a healthy lifestyle. This article introduces an inquiry-based learning approach that combines physical-embodied learning with cognitive-knowledge learning. It is a

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student-centered active-learning approach focused on questioning, critical thinking and problem solving (Padraig & McLoughlin, 2009), and a method intended to stimulate the students to think, act and use all of their competencies — both cognitive and physical. Further, the approach makes PE relevant, meaningful and challenging, and it lets the students collaborate within a given task in a secure and positive context, all of which are factors that influence the students' motivation in a positive way (Alderman, Beighle, & Pangrazi, 2006; Xiang, McBride, & Guan, 2004) and may encourage students to continue the physical activities outside of school.

Inquiry as a Learning Approach

Inquiry in Education, Everyday Life and in Sport Contexts. The inquiry approach is often related to education in the natural sciences, and it is not usually implemented in PE. However, inquiry is often conducted both in everyday life as well as in sport contexts. Skills such as observing, experimenting, classifying, developing a hypothesis, drawing conclusions, designing, planning, and so on are used for inquiry (Millar, 1989). For example, planning, developing a hypothesis, and experimenting are used in everyday life when we make spaghetti sauce without a recipe, or when we want to improve a known recipe. Sports have examples of inquiry as well. When Dick Fosbury jumped over the bar in a new way in the late 1960s, he had experimented, conducted fair testing, planned, and designed for a long time in order to perfect his skills (Bar-Eli et al., 2006); and Shaun White had no doubt designed, planned, experimented and tested his fantastic snowboard tricks many times before performing them for the world to see. He does that in his private "snow laboratory" in Colorado (English, 2010).

Origin and Progress of the Inquiry Process. Education, and especially learning, founded in inquiry can be traced back to John Dewey in the beginning of the last century (Dewey, 1975/1913), when he introduced a more student-centered form of learning as opposed to the very well-known formal teacher-directed, one-way method of teaching. The student had to learn by being "wholeheartedly active in acquiring the ideas and skill needed to deal with the problems of his expanding life" (Dewey, 1913/1975, p. vi). "Learning by doing" is a sentence that is often connected to Dewey's idea, and that phrase has inspired many innovative educational ideas over the years. Originally, the idea of inquiry was connected to the way scientists worked, especially within the natural sciences, and in the 1970s great efforts were made to incorporate this process in educational programs where students acted like "little scientists" (Woolnough, 1989). At the beginning of the 21st century a new wave of inquiry-based learning was implemented in school science education, not only in Western countries such as the United States and the United Kingdom but also in Asia and Africa (Østergaard, Sillasen, Hagelskjær, & Bavnhøj, 2010). This last wave of inquiry was not only initiated because the inquiry-based learning approach was seen as an adequate way of educating students in different subjects, but also because projects conducted via inquiry-based learning had emphasized the approach as highly motivating and interesting for students. Girls and groups of students not learning effectively by means of their traditional deductive approach were especially pleased with the new learning approach (Rocard et al., 2007).

Inquiry is often conducted both in everyday life as well as in sport contexts. Skills such as observing, experimenting, classifying, developing a hypothesis, drawing conclusions, designing, planning, and so on are used for inquiry.

The overall four phases of an inquiry process are outlined in Figure 1, in which it is shown that the initial step in the process is a question, a problem or a challenge (*Teacher-chosen subjects* or *Students' ideas or questions*, Figure 1). In relation to PE, the question can, for example, be related to obesity and physical activity: "Which forms of physical activity are the best to burn off calories?" Or it can be a challenge dealing with the lack of motivation of not-so-skilled players in relation to soccer games often taught in PE (Munk & von Seelen, 2012): "How is it possible to plan a soccer game that motivates all students and not only those who are used to playing in soccer clubs?"

Questions or challenges such as these can be raised either by the students themselves or by the teacher. Then the students are to search for possible explanations for the questions or challenges (*Problem clarification,* Figure 1). They are to formulate predictions or hypotheses in relation to the problem they are dealing with. It is preferable for the students to be left alone for a few minutes to think about their own solution to the problem and write it down (*Making a hypothesis*, Figure 1). Organized in small groups, the students can then compare and discuss their suggestions, and together they can form a common hypothesis or a prediction of how the raised problem can be solved, based on their prior understanding, experiences and knowledge in relation to the challenge they are dealing with. For the question about physical activity and calories, a possible prediction or hypothesis can be that a five-minute Sharkey step test is more efficient at burning off calories than a 12-minute Cooper test.

The next step is the investigation (*Test the hypothesis*, Figure 1). Together the students are to test their prediction or hypothesis, and to do this they first must plan, design and conduct the investigation. For example, the students can search and read literature in preparation for the experiment; find, calibrate and arrange equipment; and make plans for observations and registration of data to reach valid conclusions in relation to their prediction or hypothesis. Either by themselves or in cooperation with other students they are to conduct an experiment and collect data, which are subsequently interpreted, discussed and put into perspective in order to come to a final conclusion (*Conclusions, validation and contextualization,* Figure 1). Based on their initial prediction or hypothesis, their findings and conclusion either confirm the students' existing knowledge or lead to new knowledge, or maybe to new investigations (*New questions to research?,* Figure 1).

In this example the students would perform a Sharkey step test and a Cooper test wearing an accelerometer, and afterward they compare the findings with the initial hypothesis (which is naturally dependent on the weight of each individual student, effort in the exercise, and other factors) to reach a conclusion.

Critical Learning Perspectives. In addition to the motivational and learning benefits of an inquiry-based approach, and as

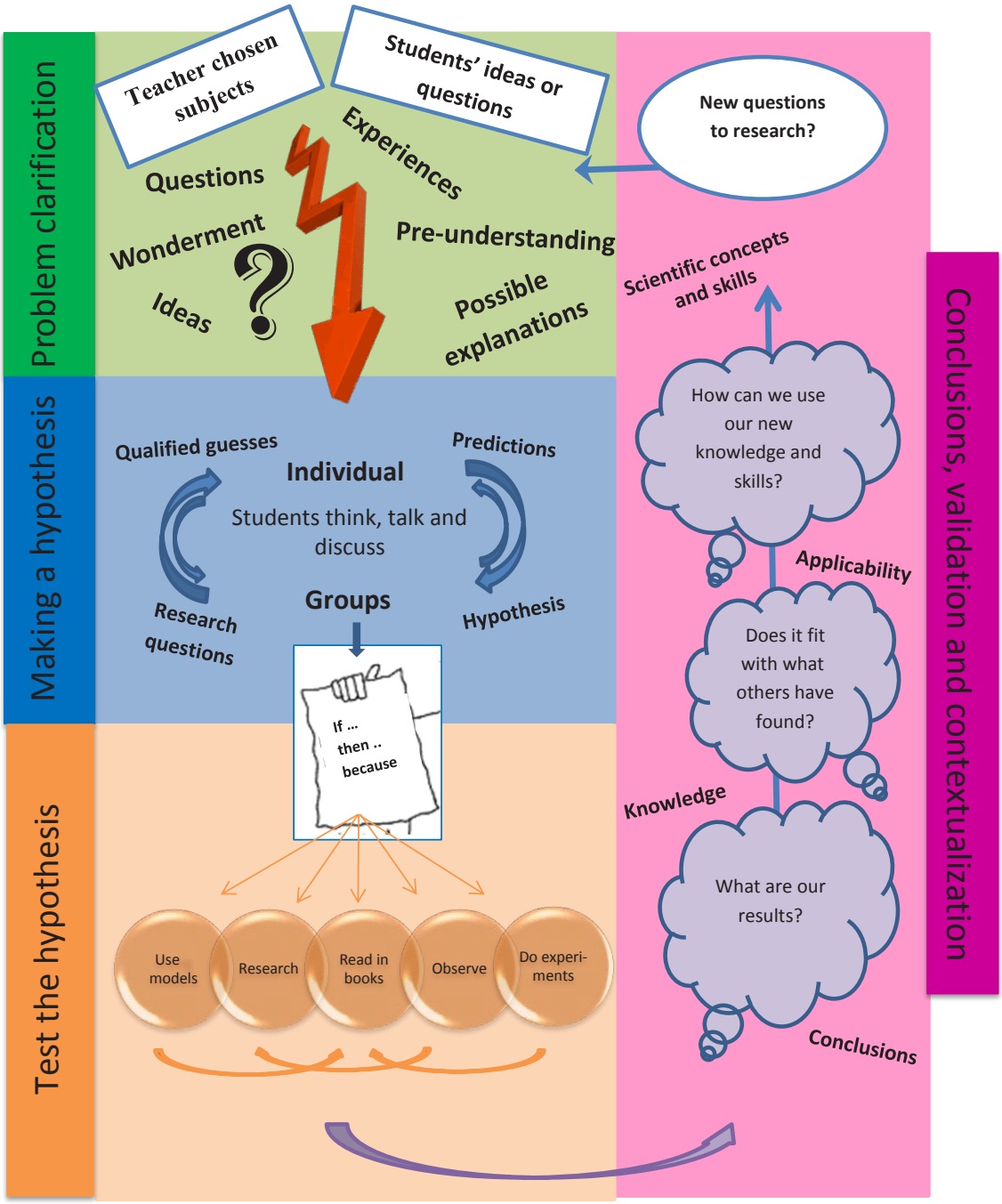

Figure 1.
Model of the four phases of the inquiry process

mentioned in the first section, the approach supports a far more critical and reflective learning perspective in relation to traditionally taught PE (Wright, Macdonald, & Burrows, 2004). In a book about critical inquiry and problem solving in PE, Wright (2004) argued, "Critical thinking, critical inquiry and problem-solving together with related concepts such as critical reflection and critical engagement are some of the main abilities/capacities needed by young people" (p. 6). In other words, if students are educated using an inquiry-based approach in PE, they not only enhance their cognitive and physical competencies and seem to be more motivated and engaged in the lessons, but they will be more skilled to handle the diverse challenging tasks that PE, physical activities, sports and leisure time may present in the future (Kirk, 1997; Wright, 2004). A recent project in which an inquiry-based approach was implemented in physical education teacher education (PETE) definitely showed signs of critical thinking and critical reflections in the inquiry and problem-solving approaches to the challenges with which the students were confronted.

Table 1.
Inquiry-based Learning Project in Physical Education Teacher Education

Group	Sports Arena	Ball Game	Example of Curriculum-related Learning Goals
Group A	Outdoor playing field	Soccer	• Combine skills to participate in modified versions of team and individual sports. • Relate to both psychological and physical reactions during play. • Demonstrate appropriate relationships of the body to an opponent in dynamic game situations, such as staying between an opponent and goal and moving between an opponent and the ball.
Group B	Big sports hall	Basketball	• Accept the roles of group members within the structure of a game or activity. • Apply locomotor, non-locomotor and manipulative skills in team physical activities. • Feel the joy of playing and become a better basketball player.
Group C	Small sports hall	Handball	• Understand the importance of communication in a game. • Work cooperatively in a group to achieve group goals in competitive as well as cooperative settings. • Identify the contributions of the members of a group or team and reward members for accomplishing a task or goal.

An Inquiry-based Learning Approach Implemented in Teacher Education

Future PE teachers are often confronted with the following initial problems regarding tasks: As new PE teachers they will be met with both curriculum rules to be fulfilled and practical restrictions related to where they are to teach their students. Do they have access to a sports center? How big and well equipped is it, and are there outdoor sports facilities at all? In fact, this is a real problem for many schools in cities with a dense population and presents a challenge for future PE teachers.

In a project with an inquiry-based learning approach in PETE, 32 students in a teacher-training college were challenged with three different teaching venues and curriculum rules with learning goals for grade 8 (14–15 years old). The main question was how to teach ball games in different settings in order to point out at least three learning goals/curriculum-related rules (*Teacher-chosen subjects*, Figure 1). Divided into three groups (8 to 12 students in each group; see Table 1), the students were given a sports arena (an outdoor playing field, a small and a big sports hall), and, subsequently, they had to discuss, argue for and decide which type of ball game would best fit into their particular setting (*Problem clarification*, Figure 1).

After discussion and selection of a ball game in relation to their sports arena, the students had the opportunity to try out their ball game (see Figure 2a–c). After having practiced the different ball games for around an hour, the students were confronted with the curriculum rules for grade 8. First, they were asked to work individually and choose three to five different curriculum-related learning goals that seemed relevant to their particular ball game before they split into pairs (still focusing on the same ball game) to discuss and compare the elected goals and then agree on three to five curriculum-related learning goals. Finally, all the students working with the same ball game were grouped to discuss, argue for and agree on just three relevant curriculum-related learning goals, which they could relate to their elected ball game (*Problem clarification*, Figure 1).

The next challenge for the students was to formulate a prediction or a hypothesis (*Making a hypothesis*, Figure 1) built on their former discussions regarding possible explanations #1 and #2: How would they integrate the three chosen curriculum-related learning goals into teaching their selected ball game (soccer, basketball or handball, respectively)?

Example of a Prediction or Hypothesis

• Soccer: By using communication in soccer it is possible to enhance the students' reflections on physical and psychological reactions during the game.

• Basketball: If the students have specific roles to play in the basketball game, they all have to be active and involved and thereby they will all be motivated to play.

• Handball: Timeouts can be used for reflection and for articulating intuitive and tacit knowledge.

All groups discussed, argued, reflected on and formulated hypotheses, and subsequently each group went to their sports arena and investigated their hypothesis (*Test the hypothesis*, Figure 1). They designed and planned a game with modified rules by experimenting with known rules; they worked with fair testing; some of the students tested the new game while others observed, collected data, registered and classified the game; and finally the students discussed their findings. Based on the discussions, the game was modified once more (by fair testing), and again the game was tested. In other words, the students experimented with the rules of their game to see if they could shed light on the hypothesis.

On the last day of the inquiry unit all groups presented their specially designed and modified game, whether it was soccer, basketball or handball. When one group presented their game, the other groups acted as players. After each ball game the group presented their hypothesis, and all students and their teacher discussed the game in relation to the hypothesis: What worked and what

did not work? Was it possible to improve the game? Would it work in grade 8 with as many as 25 students? (*Conclusions, validation and contextualization*, Figure 1). There were many good discussions and suggestions and the students argued very well and critically for their standpoints. One of the groups developed a fairly good ball game with modified rules in reply to their hypothesis, thus fulfilling the chosen curriculum-related rules, while the other two groups did not succeed in developing ball games that aligned with their hypothesis (leading to *New questions to research,* Figure 1). In their efforts to plan, design and accomplish a new game, the two groups forgot the specific stated hypothesis and related their game to more general pedagogical principles. Nevertheless, all students showed engagement during the inquiry unit; they worked hard to agree on learning goals and predictions, and in their investigation of the hypothesis they used both their cognitive and physical competencies.

Example of an Investigation. The group that focused on handball divided their players into four minor groups with five to six players in each team. At the beginning the teams were asked to discuss and agree on a strategy for the coming handball game. The teams were then asked to play a game, where each player had to touch the ball at least once before they tried to score (a modification to secure participation of all members of the community). After the teams had played for a short time (2–3 minutes), the players were asked to hold a timeout during which they had to discuss and verbalize how they used their body in play against their opponent. This was a way for the more skilled players to reflect on and articulate their intuitive and tacit knowledge so others could learn to use their body in feints (e.g., in the next game, where all players paid attention to different types of body feints).

The most important aspect was that the players acted as a community of practice (implementation of a learning theory) and had a special focus during their timeout. They did not focus only on how to play the ball, but on how to use their body in gameplay, leading to critical reflections about the way they played.

At the end of the session the students discussed the implementation and effect of such a game in secondary PE. They questioned the existing practice and discussed how to implement the modified game. These considerations are examples of second-order critical reflection, according to Wackerhausen (2009).

Figure 2.
Students discussing possibilities in the outdoor playing field (2a). In the big sports hall (2b) the students rather quickly chose basketball as their ball game, while the students in the small sports hall (2c) discussed different forms of ball games and which one to choose.

> **"It is another approach to PE… much more reflective… You need to express your thoughts and to argue…to express your tacit knowledge. We spent a lot of time in our group explaining and discussing what we did and why… In soccer, for example, it was not just about winning and not losing. It was about understanding the game."**

What Did the Students Learn?

Based on video recordings before, during and after the inquiry-based learning unit, audio recordings of the students' discussions during the unit, and both written evaluations (all students) and a formal group interview (eight participants), signs of engagement and learning were clearly identified — not only in the group that succeeded in finding a good solution to their hypothesis, but for all of the students participating in the inquiry work.

During the inquiry unit the students learned by using their physical skills in combination with their cognitive and communication skills. In the sports arenas the students performed, showed, corrected, acted, communicated, exercised, gave each other feedback, and used knowledge and experiences in an attempt to reach a consensus related to the elected ball game. These are examples of learning activities that are not often used in traditional, teacher-structured learning in schools, neither in primary, secondary or high schools, nor in teacher education programs (Dyson, 2006; Nyberg & Larsson, 2014).

On the basis of their experiences and common knowledge of PE, the students argued, discussed, reflected and critically considered curriculum-related rules, learning goals, rules for game play, and how they could develop new games. All these skills are related primarily to communication and cognitive learning. However, the skills are undoubtedly inseparable from bodily experiences and knowledge, and this combination of communication, cognitive and bodily knowing and learning, both in sports venues and in the classroom, is highly usable for future teachers as well for students in primary or secondary schools.

In the students' evaluation of the inquiry unit, many expressed that they had learned to value collaboration and communication in PE, and to reflect, be critical, give feedback, be constructive,

Table 2.
Examples of Topics for an Inquiry-based Learning Unit

Topic	Girls' participation in PE is a general problem. How is it possible to engage girls in PE?	Competition can be a problem due to the diversity of students' abilities. How is it possible to reduce the focus on competition in ball games?	Enhance the "fun factor" in PE. To engage more students in PE, it is very important that the fun of PE is boosted.	Drug abuse has become common in sport (a theoretical topic for high school students). How is it possible to reduce drug abuse in American football?	Fair play in sport may be encouraged through a greater focus on peer relations and collaboration in general.
Hypothesis	If girls are responsible for planning and designing exercises and games to be performed in PE, they will engage more, as girls like to be creative (Bailey, Wellard, & Dismore, 2004).				
Intervention	Let the girls be responsible for the next two PE lessons (it is important that they have some guidelines for creating their plan).				
Conclusion	As the teacher, you have to observe the girls' activity and, following the lessons, talk to the girls (and the boys) about their experiences.				

Table 3.
Hints and Guidelines for Inquiry-based Learning in PE

Primary School: The inquiry has to be facilitated and guided.	*Challenges* need to be specific and relate to simple problems. Example: "How many ways can you throw a ball?"	*Hypothesizing* needs to be guided and consist of drawings or simple descriptions. Qualified guesses may be used as hypotheses.	*Investigation* has to be simple and give a clear answer. The teacher needs to guide the students in their interventions.	The teacher needs to have the final word, and correct mistakes in the *concluding* discussion.
Secondary School: The inquiry process can be more open-ended.	*Challenges* have to be realistic and relevant for the students.	It is important that the *hypotheses* are written (or audio recorded) to ensure that the students spend time discussing and formulating them.	*Investigation* has to be simple and give a clear answer. A blurred answer raises too many questions and related problems.	It can be given as a challenge that the students must find material (e.g., on the Internet) that can support and validate the *conclusion* to the hypothesis.
High School: The inquiry has to be open-ended.	*Challenges* can be more theoretical.	The students need a framework to structure their *hypothesis* (and the ensuing investigation).	The students can use the Internet in their *investigation* of either a practical problem or a more theoretical one.	
Physical Education Teacher Education	*Challenges* can focus on the students' own education and/or their coming practice as a PE teacher.	It is important that the students have a critical-reflective approach when formulating the *hypothesis*. Inspiration can come from newer learning theories.	The *investigation* can be in the form of a learning unit for either fictitious classes or classes invited to participate as "investigative classes."	It is the students themselves — guided by the teacher — who have to *conclude* and discuss for or against the chosen solution to the stated hypothesis.

Based on Wright, Burrows and MacDonalds (2004) and Spronken-Smith et al. (2011).

articulate tacit knowledge, and combine bodily experiences and cognitive knowledge — all skills related to the way students achieve knowledge (Wright, 2004). In other words, by using an inquiry-based learning approach the students had learned to teach physical education.

A statement from the interview, representing the attitude of many of the students, covers a large number of the benefits of the inquiry-based learning unit:

> Inquiry worked for me as a great eye-opener…a cool method. It is another approach to PE…much more reflective… You need to express your thoughts and to argue…to express your tacit knowledge. We spent a lot of time in our group explaining and discussing what we did and why… In soccer, for example, it was not just about winning and not losing. It was about understanding the game…to learn about the game — both the tactic play in the field, as well as how to make a deliberate throw-in, for example… We need to think about these learning goals when we are going to teach. Personally, I learned a lot from the inquiry unit. (Sally, 22 years old)

The students' reflections on the use of their body, the tacit knowledge articulated, and how they discussed the ball games show that they formed a new learning approach in which they had to use bodily experiences and cognitive knowledge, and be involved and engaged.

Challenges of Using an Inquiry-based Learning Approach in Physical Education

As illustrated, inquiry-based learning in PE seems to have the potential to combine bodily experiences and cognitive knowledge in a way that encourages students to be involved and engaged. Used in practice, the method nevertheless presents some big challenges. The most important one is that PE teachers need to be either experienced teachers or highly motivated new teachers who can support and help the students during the inquiry unit (Hmelo-Silver, Duncan, & Chinn, 2007; Savery, 2006). The teachers must facilitate and guide the learning by, for example, encouraging higher-order thinking and reflections, providing information in the form of references to relevant literature, or conducting demonstrations of relevant equipment that can help and bring the students further with their investigations. In inquiry work it is important to stress that the traditional PE teacher role has to be reversed to that of a facilitating, guiding, personal-coaching role. This change

demands a positive, prepared attitude, and it may take many hours of practicing inquiry-based learning before this approach feels natural (Harlen & Allende, 2009).

Another challenge of working with an inquiry-based learning approach is the students' existing reflective and communication skills. It is important that the students, no matter whether the method is used in a school or teacher college, have the ability to argue, discuss, reflect on and respond critically to their own and other students' practice(s). Communication and related skills are central when working with an inquiry-based learning approach (Østergaard, 2012), and challenges may arise when, for example, primary school students' communicative skills are not yet fully developed (Burleson, 2007). When guiding and facilitating the students, the teacher should be aware of their reflective and communicative skills, and it may be necessary to first promote those skills by using different strategies — for example, by asking open-ended questions and accepting conflicting interpretations (Epstein, 2003). Despite this challenge, by creating learning environments that support the inquiry-based learning approach and by training students, these difficulties can all be handled (Harlen & Allende, 2009).

Conclusion

With these challenges in mind, inquiry-based learning in PETE has shown that the students enhanced both their physical and cognitive learning by using both bodily experiences and cognitive knowledge, as well as communicative skills and inquiry-based skills. On the basis of the results described in this article, together with the outcome of research regarding inquiry-based learning in other settings, it can be concluded that even though inquiry in PE may not be well developed or described, it certainly has potential as a motivational learning approach to engage students and give them the opportunity to develop competencies to continue pursuing physical activities inside and outside of school. Tables 2 and 3 provide inspiration, guidelines and hints to assist teachers in implementing an inquiry-based learning approach.

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