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Article

Practical research on the use of digital pens in high school rugby club activities

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Abstract

Tactics play a crucial role in sports; however, coaching presents various challenges. This study examined the impact of utilizing practice notes created with a digital pen capable of simultaneously recording and playing back both audio and texts/drawings on tactical understanding. The participants were high school rugby team members and coaches. The results of a four-month practical investigation revealed that the learning experiences of tactical understanding in high school rugby teams manifested through four categories: awareness of the difficulty of tactical understanding, exploration of experiential facts, contemplation, and integration into practice. It is speculated that the utilization of the digital pen not only encouraged a deeper understanding of tactics through the formation of a meta-perspective but also led to learning strategies aimed at activating knowledge.

Keywords: Practice Notes with Voice and Drawing; Tactics Learning; Reflection.

1. Introduction

Understanding and practicing tactics play crucial roles in sports coaching (Uchiyama, 2007). Notably, tactics in ball games are considered among the most influential factors in determining athletic performance (Aida, 1994). However, teaching tactics in actual coaching situations presents several challenges. For instance, difficulties arise when applying and practicing a tactic in different situations over time, even if a player successfully practices the tactic on the field during instruction (Kitamura et al., 2014). Bruer and others have pointed out the challenge of teaching problem-solving strategies when students could solve a problem immediately after instruction but struggled to apply it spontaneously later, suggesting that knowledge might not be effectively activated (Bruer, 1993/1997).

Solutions to these issues involve repeated instruction and creating learning situations that connect students' problem-solving scenarios (Bruer, 1993/1997). Despite the Ministry of Education, Culture, Sports, Science, and Technology's (MEXT, 2015) emphasis on applying learned knowledge in thinking, judgment, and expression in courses of study, practical situations often present limitations in information availability. Due to space and time constraints, coaches' instructions on tactics tend to be one-sided and temporary, possibly failing to achieve sufficient understanding (Ichimura et al., 2009).

In response to the aforementioned challenges in teaching tactics, researchers have emphasized the importance of fostering understanding through repetitive learning and utilizing players' own practical experiences as learning materials (Matsuo and Maruno, 2007; Uesaka, 2010; Kikukawa and Saiki, 2013; among others). One strategy for supporting learning through repetition is the integration of information and communication technology (ICT) equipment. Numerous studies have highlighted the effectiveness of learning using ICT equipment. Murakami (2020) reported that incorporating ICT into basic nursing education was effective in enhancing learning motivation.

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Nakamura et al. (2019) found that the use of ICT in science education can be effective in developing qualitative abilities. In the field of sports, Nakajima et al. (2022) suggested that ICT could be an effective teaching tool for skill improvement. Shigeta (2014) reported that ICT-enhanced classes, such as those employing flipped learning, were expected to have positive educational effects. Kitamura et al. (2013, 2014) discovered that the use of digital pens in learning, particularly among high school and university students, plays a crucial role in facilitating reflection and understanding.

Despite the series of studies conducted, there remains a noticeable gap in the research concerning the effects of ICT device utilization on learners' learning processes, including how these devices influence the way learners acquire knowledge. Moreover, there is a lack of sufficient practical research grounded in theoretical frameworks on the application of ICT devices in real sports practice scenarios and their potential to enhance players' learning experiences. Specifically, comprehending instructional content solely during practice is challenging, emphasizing the importance of the repetitive learning of tactics outside practice situations within the context of problem-solving scenarios. This is essential for achieving a profound understanding of instantaneous decision-making during gameplay. Consequently, there is an urgent need for research that establishes the connection between understanding and practice.

The primary objective of this study was to elucidate the impact of using a digital pen for tactical instruction on players' understanding of tactics. Specifically, this study utilized a digital pen equipped with a built-in IC recorder capable of synchronously capturing voices and handwriting (Echo Smartpen). During the post-practice review, the coach employed a digital pen to explain the tactics, and the players subsequently reviewed the instructions before the next day's practice. This study aimed to discern how tactical instruction delivered through digital means, in conjunction with on-field guidance, influences players' comprehension of tactics and shapes their overall learning experiences.

Given the study's focus on analyzing internal factors within the coaches and players, particularly the nuances of their experiences related to tactical understanding, a qualitative research method was deemed appropriate (Kitamura et al., 2005) and adopted as the methodology for this investigation.

2. Methods

2.1. Participants

This study involved 45 participants from a public high school rugby club, comprising 39 players, 4 managers, and 2 coaches.

2.2. Procedure

Figure 1 shows an overview of tactical learning using digital pens. After practicing on the ground, the coaches create a notebook with audio, text, and drawings using digital pens to explain the issues during practice and points for the next practice session. The notes are shared via Dropbox, and the players watch the notes at home or school before the next practice session using a smartphone or PC. This cycle of tactical learning through practice and reflection is repeated. Figure 2 shows a tactical practice note created using a digital pen.

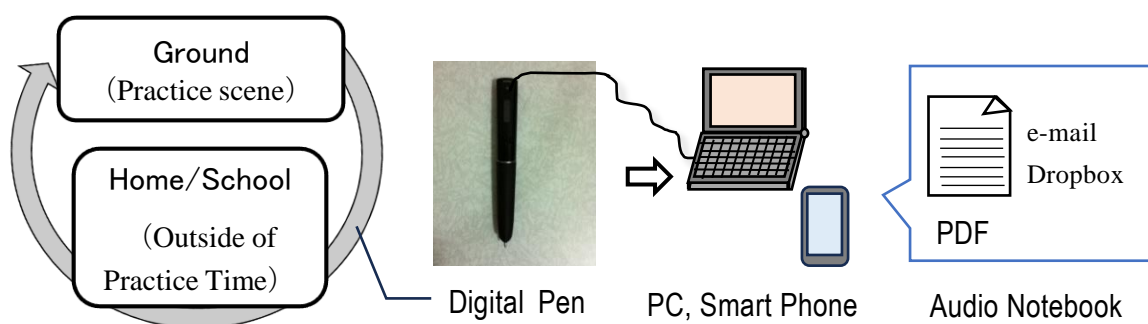


Figure 1. Overall view of tactical learning with digital pens

- Digital pen developed by Livescribe, a Gakken Education Publishing company
- Capable of synchronously recording text and voice
- Capable of managing text and voice data on a PC

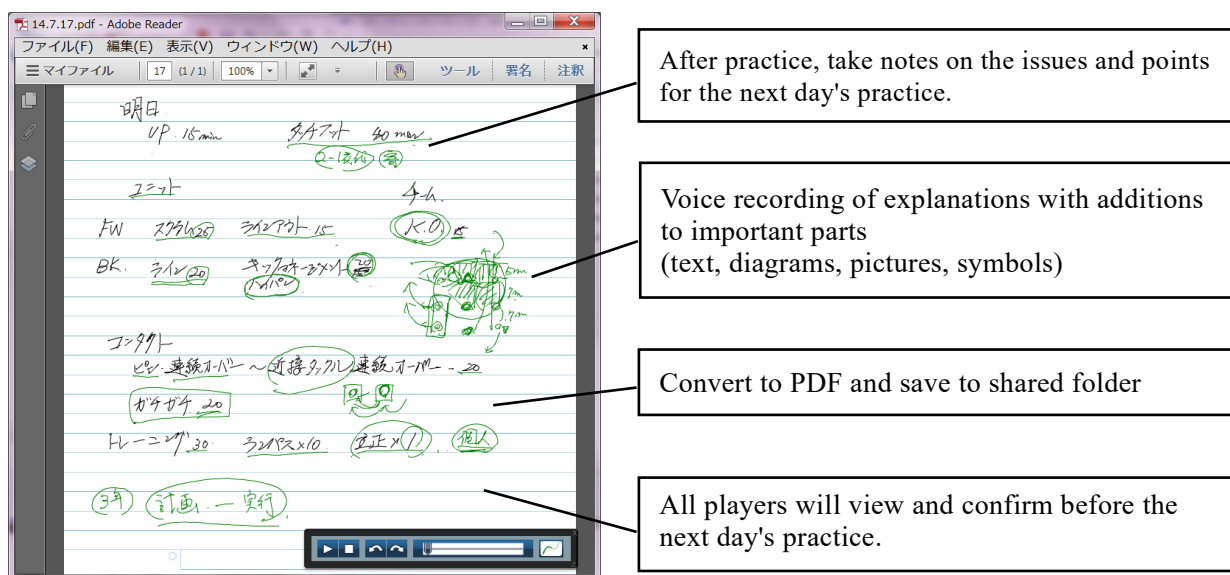


Figure 2. Composition of tactical practice note created using digital pen

The survey was conducted over a four-month period, from October 20XX to January 20XX. Prior to the survey, the functions and uses of the digital pen used in the study were explained. All participants were then asked to use the pen freely for two weeks to ensure that they were familiar with its use.

2.3. Data collection: Use of digital pens

After a practice session, the two coaches made notes using a digital pen. They wrote explanations in a notebook while speaking aloud and recorded their voices. The notes were saved as PDF files and stored in a Dropbox folder shared by the members of a rugby club. All club members looked at the PDF notes before the next day's practice session, reviewed them, and confirmed the key points in their tactics. Figure 3 shows an example of an actual tactical practice note recorded using a digital pen with synchronized voice and handwriting.

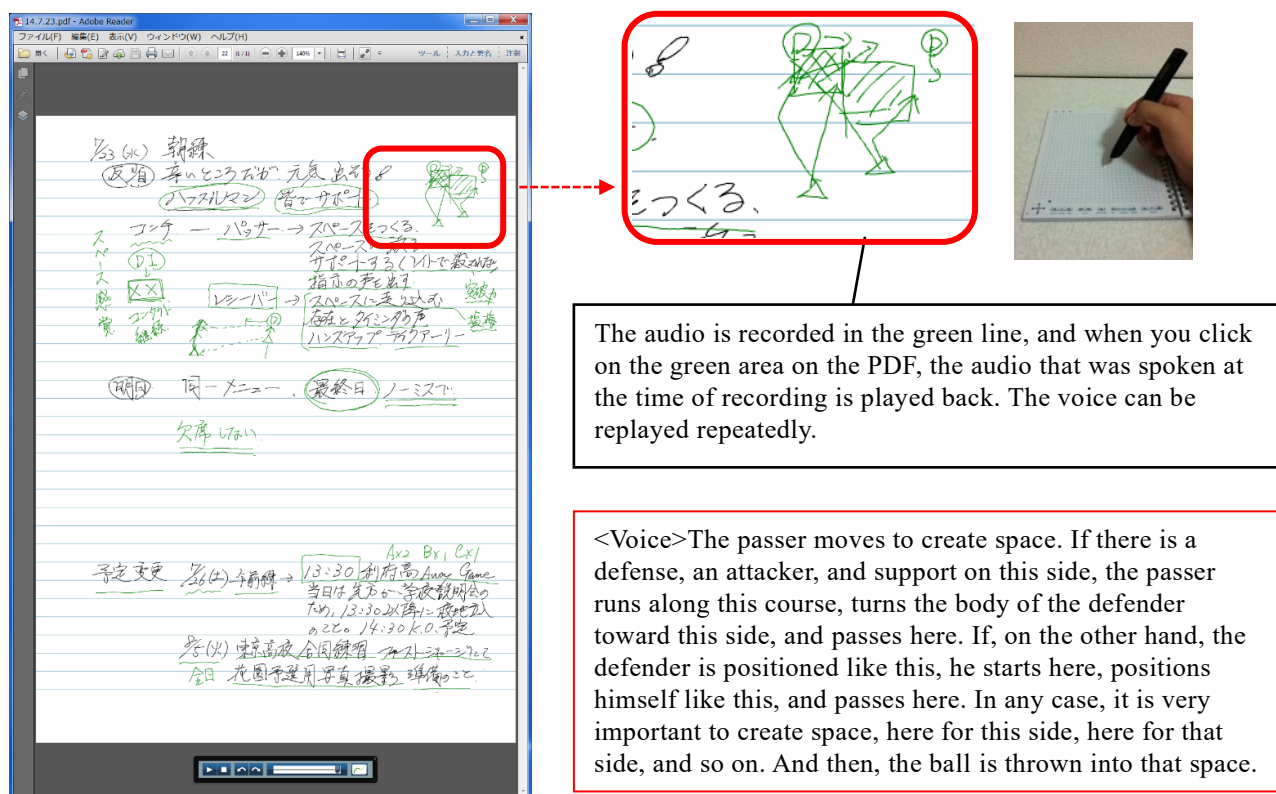


Figure 3. Example of a tactical practice note with digital pen

2.4. Data collection: Interview survey

Data were collected every month through semi-structured, in-depth, open-ended interviews using stimulated recall with the coaches and all team members based on the contents of their notebooks and audio recordings. We conducted semi-structured interviews. The interviews were conducted retrospectively, focusing on the coaches' intentions, thoughts, feelings, and perceptions regarding what was described in their notes. Interviews with players and managers were conducted before, during, and after the practice sessions, focusing on their experiences with the digital pen.

2.5. Data analysis

The voice data obtained from the interviews were converted into text, and hierarchical categorization was conducted based on the qualitative data analysis methods of Côté et al. (1993) and Patton (2002), with multiple researchers involved in the analysis process.

2.6. Credibility and certainty

The quality of the study was evaluated according to authenticity (reality of the data) and certainty (reliability of the data and procedures).

First, to concretely describe the details of the participants' experiences, a survey was conducted on their practice situations and interviews were conducted concerning their digital pen descriptions. Second, interviews were conducted in a semi-structured manner to standardize the questions posed to various participants and ensure the reliability of data collection. Third, the analysis was based on written notes and audio recordings, treating the content of the participants' narrative descriptions as the focus of the analysis, thereby ensuring data reliability. Fourth, the data analysis process was shared between several experts, and the analysis was conducted through multiple discussions to ensure reliability.

3. Results and Discussion

An analysis of 165 meaning units (semantic content elements) revealed that the learning experience associated with the use of digital pens for tactical instruction in rugby could be categorized into four themes: representation of disincentives, exploration of experiential facts, thinking through ideas, and incorporation into practice. The following provides a detailed description of each category.

Table 1. Hierarchical Category and Key Utterance Lists

Category	Subcategory	speech example
Representation of disincentives	-Difficult to understand in practical situations -I cannot remember -Chain of Unknowing	It is so difficult that I only understand about half of what is going on in that scene.
Exploration of experiential facts	-Multifaceted information from text, drawings, and sound -Repeatable listening -Use of temporal and spatial convenience -Cues to deeper and broader explanations	You can confirm points that are not clear after hearing them once by listening to them repeatedly.
Think through the ideas	-What went wrong? -Just what I wanted to ask -Looking for the point -What was the point?	Listen to what the teacher emphasized and look back to see what mistakes you made.
Incorporation into practice	-Understanding of the meaning of their own movements -Awareness of relationship with other players -Relation to acquired skills	See yourself from the outside during practice and visualize what you need to do next

3.1. Representation of Disincentive

This category comprises subcategories such as “difficult to understand in practice situations,” “I cannot remember,” and “chain of unknowns.” The participants shared their experiences of confusion during practice sessions regarding the tactics explained by the coach, including challenges such as not understanding them immediately, difficulty comprehending them, struggling to remember them even after practice, and persistently not grasping them. As they verbalized these difficulties in understanding tactics during practice, they gained awareness of various factors hindering comprehension — factors that they had vaguely sensed.

One player elucidated a problem in tactical practice: *“During practice on the ground, the teacher explained to me what was happening.” (Player T)*

Player A highlighted the challenges faced during tactical practice: *“The teacher explains it to us on the field during practice, but it is so difficult that I can only understand about half of what he says.”*

Player J described an experience that was challenging to understand even upon recall: *“During practice, I just kind of get through it by imitating everyone else. When I go home and try to remember and understand, I often forget things, and what I hear and see during practice is limited, so I often don't understand.”*

One player highlighted the challenge of entering the next practice session without a full grasp of the tactics, resulting in insufficient practical application. *“Tactics are difficult. Even in practice, I think I understand when I am told, but when I actually play, I don't understand. I would go back to practice the next day without really understanding what was going on. In fact, I often couldn't use the same moves in games.” (Player F)*

The following three categories illustrate how digital pens offer solutions to these issues.

3.2. Exploration of Experiential Facts

This category comprises subcategories such as “multifaceted information from text, drawings, and sound,” “repeatable listening,” “use of temporal and spatial convenience,” and “cues to deeper and broader explanations.” These subcategories were established to capture awareness of the search for facts about the experience occurring during the practice sessions while maximizing the functional convenience found in using a digital pen.

One player, highlighting the advantages of multifaceted information, remarked, *“The practice notes written with a digital pen are easy to understand because you get a variety of information through text, pictures, and voice.” (Player B)*

Another player emphasized the benefit of repeatedly listening to the video for confirmation: *“I can't understand a point after hearing it once. I can listen to the notes repeatedly to check points that I couldn't understand just by listening to them once.” (Player H)*

In addition to the convenience of the digital pen, the players expressed appreciation for the coaches' detailed explanations about the device. They valued the coaches' ability to delve deeper into the points covered during practice sessions and craft instructional content for problematic situations. One player articulated this sentiment: *“The teacher's explanations were very helpful. His insights into mistakes made during practice, including discussions on their causes, potential outcomes, and countermeasures, enhanced our understanding of the situations in depth.” (Player A)*

In this manner, players actively seek clues about the facts of their actions, including information about the surrounding situations, which is fundamental to tactical understanding. Digital pens have demonstrated functionality in supporting the exploration of experiential facts from multiple perspectives.

3.3 Thinking through the Ideas

This category consists of subcategories such as “What went wrong?,” “just what I want to ask,” “looking for the point,” and “what was the point?” This signifies the experience of seeking answers to various questions that arise as preconditions for understanding, such as the “how” and “why” questions. This process occurs while watching practice notes, reflecting on one's own experiences, comparing them with the coach's insights, and relieving them.

One player articulated the experience of new questions arising as he explored the causes of his mistakes: *“I listened to what the teacher emphasized. As I listen to what the coaches emphasized and look back to check my mistakes, I contemplate why those mistakes happened, and then I ponder possible solutions.”* (Player D)

One player highlighted a situation in which new questions arise, expressing, *“While I listen to the teacher's explanations, I have new questions, such as why and how I should move. I am now more aware of the issues that need to be addressed in the next practice session.”* (Player U)

In this manner, we observed a shift in the players' tactical understanding. It moves beyond comprehending the content of an explanation to adopting a learning method that includes strategies for deeper understanding. This involves reflecting on their own movements and thoughts as well as generating new questions for further exploration during the next practice session.

3.4. Incorporation into Practice

This category consists of subcategories such as “understanding the meaning of their own movements,” “awareness of relationships with other players,” and “relation to acquired skills.” It aims to illustrate how the use of digital pens enables players to objectively grasp their movements and thoughts. This, in turn, materialize their awareness, allowing them to connect their understanding of tactics to practice from a meta-viewpoint that provides a bird's-eye view of the entire ground, including other players.

One player described the awareness of having a bird's-eye view of their own movements on the ground: *“When I am contemplating tactics while watching the practice notes, I become more conscious of observing myself on the ground from an external perspective during the next practice. This heightened awareness extends to the movements of other players, enabling us to form an image of what we should do next.”* (Player W)

One player highlighted how understanding tactics from a meta-perspective has enhanced his comprehension of the practice itself, prompting him to set goals for the next sessions. *“Since I started using the digital pen, I can better understand the very meaning of the exercises in our tactical training. I can discern why the practice is necessary, what I can achieve through it, and how it contributes to the game. Consequently, I am able to set my own goals for the next practice session.”* (Player Y)

In this manner, the use of a digital pen creates a meta-viewpoint for perceiving tactics, facilitating deeper understanding, peripheral thinking, awareness of the meaning of practice, and goal setting. This underscores the importance of incorporating this understanding into practical applications.

4. General Discussion

This study aimed to clarify how the use of digital pens for tactical instruction in a high school rugby team affects players' understanding of tactics. These efforts extend beyond merely investigating the effects of using ICT devices in sports to improve practice efficiency. This study explored the educational value of ICT devices by examining their influence on the quality of learning itself, including changes in the way learners learn and alterations in their perspectives on learning.

Figure 4 shows the relationship among the four categories: representation of disincentives, exploring experiential facts, thinking through the ideas, and incorporation into practice, derived from the analysis of participants' learning experiences, as a model for understanding tactics using a digital pen. The digital pen-enhanced learning space is represented by a circle within which the four categories are positioned in a circular fashion. Each of the four categories is located in four quadrants formed by two axes: the event/reflection and diffusion/convergence axes. The learning of tactics was placed at the center of these cycles.

The difficulty in understanding tactics, initially focused on the practice situation, becomes more diffused through the use of a digital pen. This allows the viewpoint to be directed towards one's own movements and cognition, leading to the development of thinking in a more diffused manner. The perspective of taking a meta-view of the situation forms an intention to perceive tactics from multiple perspectives and understand the situation from various angles. This is thought to activate knowledge, enabling participants to relate their learned knowledge more concretely to their practice.

Regarding the cycle of learning, a coach felt that the strategy of tactical understanding using a digital pen was effective, and stated, "Coaching with a digital pen is becoming a very effective tool for our team, which has a large time constraint." In particular, he highly appreciated the fact that he could focus on issues found during practice, organize problems about what was happening, and explain the causes and countermeasures from a bird's-eye view using drawings. He said, "If we can develop detailed instruction of skills with drawings and audio, tactical understanding will become deeper."

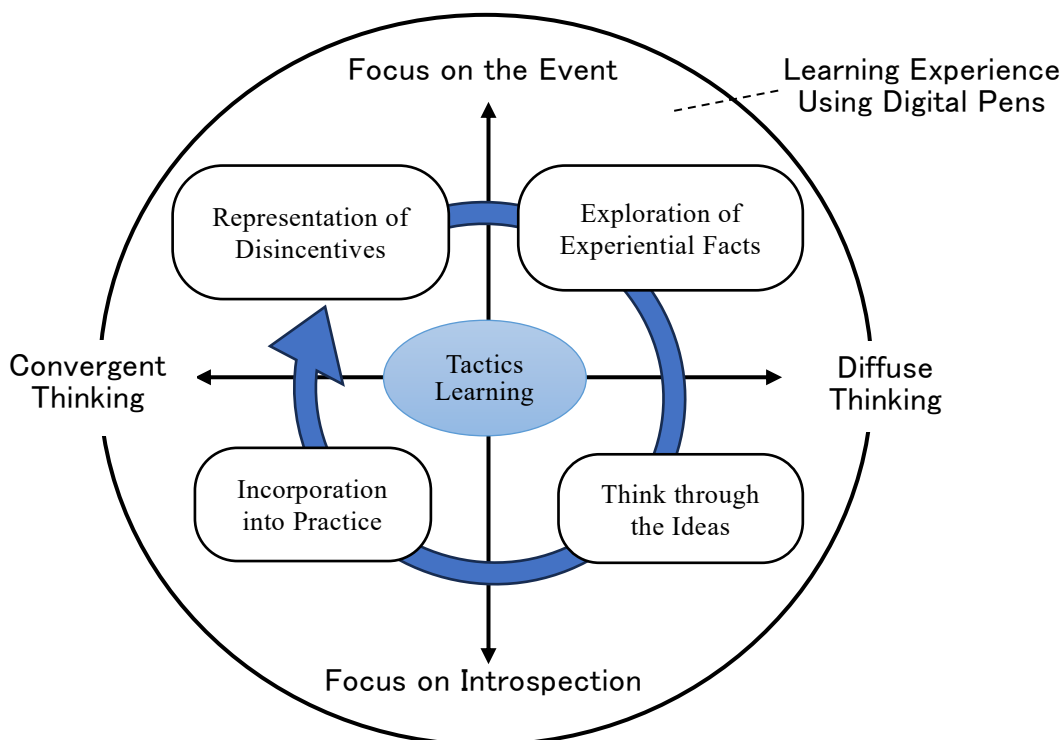


Figure 4. Circular model of tactics learning using digital pens

In addition to facilitating the understanding of individual players, the exchange of opinions among players regarding the content of their understanding stimulates communication, allows them to reconcile their understanding, and facilitates the development of practice in line with the coaches' intentions. This can be confirmed as a significant result of the tactical understanding using a digital pen.

5. Conclusion

Through the use of notebooks created using a digital pen that can simultaneously save and play back audio, text, and drawings, it became clear that the learning experience of tactical understanding in high school rugby clubs is indicated by four categories: representation of disincentives, exploration of experiential facts, think through the ideas, and incorporation into practice. The use of digital pens creates a meta-viewpoint from which to perceive tactical practice, enabling a bird's-eye view of the movements of all members, including oneself. This facilitates a deeper and more developed understanding of tactics, clear goal setting for the next practice session, and, consequently, an improvement in the quality of practice. Moreover, there was a shift in players' learning strategies towards activating knowledge.

For future research, it is necessary to verify how this method can be applied to sports other than rugby. Further studies are required to determine how the method can be applied not only to the study of tactics but also to the broader study of sports.

Author Contributions

Conceptualization, K.K.; methodology, K.K.M. and T.N.; validation, K.K., Y.M. and T.N.; qualitative data analysis, K.K. and Y.M.; investigation, K.K. and Y.M.; resources, T.N.; writing—original draft preparation, K.K.; writing—review and editing, K.K.; visualization, Y.M.; supervision, T.N.; project administration, K.K.N.; funding acquisition, T.N

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Institutional Review Board Statement

The study was conducted according to the Declaration of Helsinki.

Informed Consent Statement

Informed consent was obtained from all participants involved in the study.

Conflicts of Interest

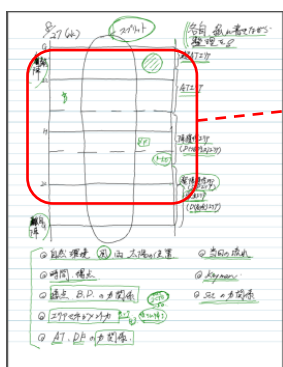
The authors declare no conflict of interest.

Acknowledgments

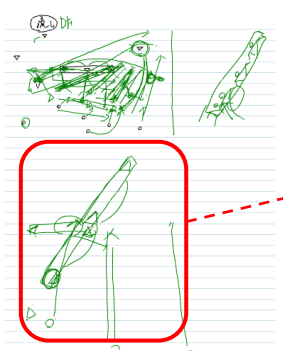
This study builds on and enhances the authors' 2014 presentation at the 65th Conference of the Japan Society of Physical Education and Sports.

Appendix

Example drawing and audio of tactical practice notes recorded with a digital pen.



<Voice>For example, what should we do if it were a scrum here? What options are there, and in what order should they be chosen? If it is a lineout here, where should it be released and what should it do? The first thing to consider is the natural environment. Especially the wind. Next is the relationship between time and score. This is an obvious factor to consider. Then there is the flow of the game on that day. If you are making mistakes, and they are continuing, what do you choose to do? Then there is the position of the opponent's key players. For example, if you have a fullback who is a very good attacker, and you just kick a long kick into the fullback's defensive area, that just provokes a counter. This will only provoke a counter. This is a very bad choice. So what should you do? So, let's assume where the key players are, especially when we consider the attacking and countering ability of the back-three.



<Voice>Now, if I cut out a certain part of that sink defense of yours, for example, it very often looks like this. The surface has already collapsed, and the situation is like this. The attack against it, for example, is dangerous here. If this person doesn't get out, space is created here, and he runs into this space, he is forced to change the direction of his body like this. As soon as he changes direction, a pass is released, and there is nothing the defense can do about it. So it is very important to be here. So, it is very important to be here, to push out like this, and to keep this side of the field unbroken. So the burden is on the person on the inside. However, he is a shadow defenseman, so the number of tackles itself should not be that many.

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