1. Introduction

There is currently worldwide demand for studies on and concrete programs for the effective health and physical education (HPE) teacher education (ICSSPE, 1999; NASPE, 1995, 2003; Paré, 1995; UNESCO, 2005). The demand for content development in teacher education is particularly high. In response to this demand, content development in electronic learning designed for PE teachers has been actively carried out (Bredel, et al., 2005; Danisch, et al., 2005; Fischer, et al., 2005; Friedrich, et al., 2004; Hanke, 1983; Popp, et al., 2005; Thienes, et al., 2005; Vesper, et al., 2005; Wurzel, et al., 2005a, 2005b). Research on effectiveness and evaluation of these contents, however, has as yet not been undertaken (Kagawa, et al., 2000; Kagawa, 2006). The result of this is that developed content has not been adequately utilized. What should be clarified in order to make such content development for PE teachers more effective?

It is necessary to make certain the goal of the content development. Introducing teaching materials to teachers and helping learners to gain better understanding of the tasks to solve would be such one. From the perspective of developing teaching skills in PE classes, however, content development should focus on improving teaching skill for observing students performance.

PE teachers need to monitor individual student progress to make student engaging in tasks (Sariscasany, 1995, p.180; Siedentop, 2000, p.10). In general, it is reported that an active teacher behavior to students during class contributes to the improving class achievement (Dodds, 1994, p.157; DSB, 1979; NASPE, 1995; Rink, 2002). In order to utilize the results of observation and to approach to students actively, it is essential for PE teachers to be sufficiently aware of the student performance. For the attainment of this awareness, it is necessary for PE teachers to recognize the objects and method of observation. In some training programs designed
for the improvement of PE teacher skill in class observation, therefore, useful observational points and their priority levels have been proposed (Graham, 2001, p.117). However, methods of improving teacher skill in class observation have not been sufficiently clarified in past studies (Siedentop, 2000, p.21). At present, it is essential to clarify the factors that can affect the improvement of observation skill of PE teacher. Thus, this study focuses on two such factors; namely, length of teaching experience in schools and content knowledge.

Teachers are categorized as 1) Novice (students, or teachers with less than 1 year of teaching experience), 2) Advanced beginners (teachers with 2 to 3 years of experience), 3) Competent teachers (teachers with 3 to 4 years of experience), 4) Proficient teachers (teachers with 5 to 6 years of experience), and 5) Expert teachers (Dodds, 1994, p.156).

According to this categorization, PE teacher skill in class observation is expected to increase as a function of length of teaching experience. On the other hand, class observation skills, do not automatically improve along with an increase in teaching years. It is essential to attain and structure specialized knowledge. In fact, it has been suggested that no appropriate judgment can be made during a game without attaining adequate knowledge (Allard, 1980, 1980a; Blomqvist, et al., 2000, 2005). Furthermore, it has also been pointed out that not only high teaching skills but also deep understanding about activities to teach are necessary for utilizing the new teaching method for games (Launder, 2001, p.13).

2. Aim

The aim of this study is to clarify the effects of two factors: length of teaching experience in school (teaching years) and expertise about subject matter content (content knowledge), on PE teacher’s evaluations of a recorded sports game using multivariate analysis.

3. Object of Evaluation

3.1. Soccer game

In general, it is essential to distinguish "what to do" from "how to do" for adequate decision making in a game situation. For example, the Japan Football Association (JFA) requires soccer coaches to have the ability to understand and analyze situations (JFA, p.12). It is regarded as particularly important for coaches to analyze games (JFA, p.13), which requires them to be aware of cues in a game (Kirk, et al., 2002). According to the beginner-expert paradigm, experts are supposed to have a greater store of the knowledge required for the awareness of such cues than beginners have. The choice of material used in this study was made in consideration of this paradigm with a focus on the following two points: 1) expertise about subject matter content could be easily discriminated by subject license and 2) length of teaching experience with the material was expected to vary. Because the JFA has specific criteria for coaching license and because soccer is played with relative frequency in PE classes, soccer was chosen as the material for this study.

3.2. Procedure for video recording

It is important to consider game rules and video recording methods in order to effectively extract game evaluation points. In this study, a soccer game played by university students as a part of their PE curriculum was used for evaluation. The game was modified based on the idea of teaching games for understanding (TGfU).

TGfU model is an instructional model which focuses on motor and affective learning domains (Metzler, 2000, p.346). Based on this model, a game should be modified in consideration of two ways. 1) game should be representative in terms of being close to an full game, 2) as well as exaggerated so that its tasks are clear (Thorpe, et al., 1986, p.166). In the unit based on this model, a series of lessons consisting of a modified game, questions, practice, and another modified game is provided (Bunker, D. & Thorpe, R, 1982).

Based on this idea, modifications were applied to the game played in the PE class so that the goals of the lesson and the tasks to solve would be clear.

Soccer games played by the first year students of university as a part of their PE curriculum were recorded by a digital video camera from behind and above the soccer court so that the entire court was recorded (Figure 1).

Each of the games was played on the court (40.2 meters long and 36 meters wide) by two teams of five players (including one goal keeper) each. The
tasks to be performed in the lessons were swift transition from defense to offense, quick ball passing to the target, and making shoots. Decision making on shoot, receiving ball at the space easy to shoot and supporting the target were set as subject matter content to be learned in the unit. In order to make these performances produce appreciable results, one of the five players of each team was required as a rule of the game to stay in the forecourt without moving into the backcourt.

The game in which the above-mentioned performance tasks had been attempted was used as the video in this study. The file format used for the video was wmv; the resolution was 720*480 pixels; the bit rate was 256 kbps; the file size was approximately 18MB; and the running time of the video was 5 minutes (Figure 1).

4. Experiment

4.1. Overview of the experiment

No previous studies have examined observational viewpoints of PE teachers for soccer games played as a part of the PE curriculum. In this study, preliminary research was conducted to explore these viewpoints before the main research was conducted.

First, a soccer game played as a part of the university PE curriculum was recorded on video in order to produce the object of evaluation. Then, the preliminary research was conducted in order to extract evaluation items that would be necessary for the collection of data for subjective evaluation of the soccer game video.

Next, using the extracted evaluation items, a questionnaire (main research) was conducted in order to quantitatively evaluate the soccer game video. Through this questionnaire, in addition to subjective evaluation data on the soccer game video, this questionnaire provided data of teaching years (years of teaching soccer in PE classes) and content knowledge (possession of a grade-C or higher JFA accredited coaching license: http://www.jfa.or.jp).

4.2. Preliminary research

The subjects in the preliminary research were 52 senior high school PE teachers in T prefecture and 35 junior and senior high school PE teachers in I prefecture. This research focused on subjective evaluations of the soccer game video, which was shown on a liquid-crystal projector. Prior to viewing, investigators explained to subjects that the video was a soccer game played by university students as a part of their PE curriculum.

After watching the video, the subjects were asked to provide their response to the question; "What do you think should be watched carefully in this video?" within 5 minutes. Their responses were provided in the form of either comments or key-words. Based on this survey, 210 evaluation items were extracted.

Because these items partially overlapped, GPAI items and procedures (Griffin, et al., 1997) which have been applied to TGfU models were used to extract significant items. Through several discussions with multiple graduate school students with experience playing soccer, 30 evaluation items were eventually extracted (Table 1).
4.3. Main research

Using the video of the soccer game that was used in the preliminary research, and the 30 evaluation items shown in Table 1, PE teachers provided their subjective evaluations of the recorded game. The web questionnaire (Figure 2) was created for efficiently collecting data from individuals who were not subjects of the preliminary research. The subjects of the main research were PE teachers at junior and senior high schools and universities. The video of the soccer game was distributed via a streaming server which was established at T university. The web questionnaire was conducted as follows:

1) First, the subjects were asked to click a link of movie file and watch the streaming video of the soccer game.
2) Second, the subjects were asked to provide answers to the question, "What do you think should be watched carefully in this video?" by responding to a set of 30 evaluation items, which were established based on the preliminary research results, using a five-point evaluation scale (Figure 3).
3) Finally, the subjects were asked to provide information about their teaching years on soccer and possession of JFA license.

The online questionnaire was conducted from January 21st to February 10th, 2005, and responses were collected from 66 participants, a number twice as large as the 30 evaluation items.

Their teaching years on soccer as a part of school curriculum varied from 0 to 30 years. Especially, 24 of the subjects held a grade-C or higher JFA accredited coaching license.

5. Experiment Results

5.1. Overview of Analysis Methods

First, the subjects were classified into groups according to teaching years on soccer as a part of the curriculum. Secondly, using these groups as criterion variables, and their subjective evaluations of the soccer game video as explanatory variables, a discriminant analysis was conducted in order to analyze the relationship between teaching years and subjective evaluations of the video. Regarding the possession of a JFA license, the same procedure was followed. Stepwise procedure was used for discriminant analysis. Stepwise procedure is a method in which feature selection is conducted based on statistical significance.
on a Wilk’s lambda value (a value which shows the validity of discriminant analysis, and which can range between 0 and 1. A value at or close to 0 indicates no population difference) for each variable in order to find the combination of explanatory variables that is useful in distinguishing groups (Watanabe eds., 2002). By this method, a linear discriminant function, in which collinearity (variable correlation) and level of significance (contribution level) are adequately considered, can be obtained.

5.2. Relationship between teaching years on soccer and subjective evaluation of the soccer game video

The relationship between teaching years on soccer and the subjective evaluation of the video was analyzed. Teaching years was segmented into groups. Discriminant analysis (stepwise method) was conducted utilizing the 30 evaluation items shown in Table 1 as explanatory variables and the groups segmented by teaching years as criterion variables. Regarding data for the groups, criterion variables were constructed with "less than * years" as 0, and "* years or longer" as 1 (* is the number of years).

It was impossible to identify the most appropriate teaching years a priori by which the subjects were segmented into groups for discriminant analysis. Moreover, this segmentation could affect discrimination to a large extent. To cope with this problem, teaching years were segmented in a stepwise manner, such as 0 to 1 year and more, and less than 1 to 2 years and more. In each case of segmentation, discriminant analysis was applied with the use of discrimination power, η (η=1-λ), in order to identify the most appropriate segmentation. Figure 4 shows the η value of discriminant analysis for each segmentation border of teaching years. The segmentation which maximize the discrimination power, η, was assumed to be best: more than 18 less than 16, and more than 10 and less than 7.

Subjects with fewer than 7 years of teaching soccer were classified into the short-term teaching group, subjects with 10 or more years and fewer than 16 years of teaching soccer were classified into the medium-term group, and the subjects with 18 years or more of teaching soccer were classified into the long-term group. The short-term group consisted of 30 subjects; the medium-term group consisted of 17 subjects; and the long-term group consisted of 19 subjects. Note that those whose teaching years were 8, 9, and 17 years were excluded from grouping due to the lack of corresponding data.

Next, the three groups classified by teaching years, i.e., the long-term, medium-term, and short-term groups, were discriminated simultaneously through

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**Figure 4** Relation between threshold of teaching period and discriminant power(η)
The results of the discriminant analysis are shown in **Table 2**, and explanatory variables that are effective for discrimination are shown in **Table 3** (Two discriminant functions were used to discriminate the 3 subject groups). Because the recognition rate was approximately 90%, determination by the evaluation items obtained by the discriminant analysis was thought to be highly accurate. In this case, the Wilk’s lambda value was 0.232. The level of significance of the corresponding p value (significance probability) was less than 1%, proving that significant discrimination was achieved by the 20 explanatory variables that were obtained.

As shown in **Figures 5** and **6**, the variables with exceedingly high absolute weight values were "Positioning in offence" in the first discriminant function, and "Using free space" and "Running into space" in the second discriminant function. These three evaluation items were thus proved to be effective for discriminating the three groups of PE teachers.

Utilizing the 20 explanatory variables the three groups of PE teachers were discriminated as shown in **Figure 7**. In the first discriminant function, In the discriminant axis I in **Figure 7**, long term samples are almost placed on the negative side, and, in the corresponding discriminant function in **Table 3**,
negative weight is assigned to "Way of using space." Thus, it is found that the long-termed teachers focus on "Way of using space." On the other hand, in a similar way, middle- and short-termed teachers focus on "Positioning in offence". As to discriminant axis II, long- and middle-termed teachers focus on "Using free space", while short-termed teachers focus on "Running into space". In sum, it seems that the shorter the teaching years, the more attention was paid to positioning in offence and that the longer the teaching years, the more attention was paid to using space.
5.3. Relationship between possession of a JFA license and subjective evaluation of the soccer game video

The relationship between possession of a JFA license (grade-C or higher coaching license) and subjective evaluation of the soccer game video was analyzed. Regarding possession of a JFA license (24 teachers held a license and 42 did not), "licensed" was shown as 1, and "unlicensed" as 0. Using such data as criterion variables and the 30 evaluation items shown in Table 1 as explanatory variables, discriminant analysis (with stepwise method) was conducted.

The results of the discriminant analysis are shown in Table 4, and explanatory variables that proved effective for discrimination are shown in Table 5. The recognition rate was 90%, indicating that discrimination by the evaluation items gained through discriminant analysis is highly accurate. The Wilk’s lambda was 0.501. The level of significance of the corresponding p value (significant probability) was less than 1%, indicating that meaningful discrimination was achieved with the nine explanatory variables that were gained. The top four variables with high absolute weight values (1.5 or more) were "Motivation for the game," "Enjoying the game," "Running into space," and "Awareness of attacking goal." These four variables were particularly dominant for discriminating possession of the JFA license. Using these nine explanatory variables, two of the groups were discriminated as shown in Figure 8.

<table>
<thead>
<tr>
<th>Index</th>
<th>Explanatory variable</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Motivation for game</td>
<td>2.556</td>
</tr>
<tr>
<td>18</td>
<td>Enjoying the game</td>
<td>2.385</td>
</tr>
<tr>
<td>4</td>
<td>Running into space</td>
<td>-1.683</td>
</tr>
<tr>
<td>21</td>
<td>Awareness of attacking goal</td>
<td>1.679</td>
</tr>
<tr>
<td>6</td>
<td>Positioning in offense</td>
<td>1.233</td>
</tr>
<tr>
<td>12</td>
<td>Selection of adequate play in game</td>
<td>-1.030</td>
</tr>
<tr>
<td>36</td>
<td>Difference of skill level between both</td>
<td>-0.926</td>
</tr>
<tr>
<td>7</td>
<td>Transition</td>
<td>0.870</td>
</tr>
<tr>
<td>20</td>
<td>Adequate team selection</td>
<td>-0.597</td>
</tr>
</tbody>
</table>

Table 4 Result of discriminant analysis (to discriminate long, middle and short term teaching period groups)

<table>
<thead>
<tr>
<th>Wilk's lambda</th>
<th>0.501</th>
</tr>
</thead>
<tbody>
<tr>
<td>P value</td>
<td>6.189</td>
</tr>
<tr>
<td>p value</td>
<td>5.203E-06</td>
</tr>
<tr>
<td>Recognition rate</td>
<td>0.909</td>
</tr>
</tbody>
</table>

Table 5 Result of discriminant analysis (to discriminate possession of JFA license)

Figure 8 Distribution of teachers by possession of JFA license
5.4. Correlation between the discriminant axis of the possession of a JFA license and the discriminant axis of teaching years

It was examined that the relationship between the discriminant axis (discriminant function) shown in [5-2] and the discriminant axis shown in [5-3]. 3 discriminant axes shown in Tables 3 and 5 were expressed as a 30 dimensional vector when variables, which were not chosen through a stepwise method, were set to 0. Angles between these discriminant axes were shown in Figure 9. If two axes produce an angle of 90 degrees, it indicates an exclusive (independent) relationship between the data extracted from these axes. The angle between the discriminant axis of possession of a JFA license (Table 3) and the discriminant axis I of teaching years I (the discriminant axis I shown in Table 5) was 77 degrees, and that between the discriminant axis of the possession of a JFA license and the discriminant axis II of teaching years II (the discriminant axis II shown in Table 5) was 112 degrees. Both angles were approximated 90 degrees, which indicates an exclusive relationship. In other words, while teaching years on soccer and the possession of a JFA license seem to be highly correlated data (discriminant criterion), their respective discriminant analyses actually extract different feature.

6. Discussion

6.1. Discussion on the relationship between teaching years and subjective evaluation of the soccer game video

The results of the analysis indicate that the PE teachers with long teaching years paid attention to "Way of using space" and "Using free space," while the PE teachers with short teaching years paid utmost attention to "Positioning in offence" and "Running into space."

In soccer, an invasion game, it is important to make and utilize advantageous space for scoring (Spackman, 1983, p.40; Mitchell, 2003, p.171; Werner, 1989, p.99). Decision making for ball games can be classified into 2 types; namely, decision making concerning tasks to be handled and decision making concerning methods to handle such tasks (Bunker, et al., 1982; Kirk, 2002; Mitchell, 2003; Roth, 1989). It has also been pointed out that decision making can be futile unless the tasks to be handled are correctly understood (Roth, 1989). Based on these indications, it can be said that PE teachers with long teaching years watched the soccer game video paying attention mainly to the tasks which should have been preferentially handled.

TGfU was proposed internationally in the 1980s and later (Launder, 2001, p.11). In Japan’s course of study for junior and senior high schools, too, the word, "strategy," began to be used for characterizing ball games in 1989 (Okade, 1998). It can be assumed that the shorter the teaching years, the higher the possibility of the teacher being provided with latest knowledge in the course of training. On this assumption, teachers with short teaching years were expected to watch the soccer game video paying utmost attention to the tasks that should have been preferentially handled. However, the results were the opposite. It was rather the teachers with long teaching years who were able to watch the game from a more appropriate perspective in this sense. In other words, the results of this study indicate that it is necessary for PE teachers to have a certain length of teaching years in order to pay sufficient attention to the tasks that should be adequately handled during the game. The results also indicate that the type of education for PE teachers that reflects the direction of international research has not yet become widespread.

6.2. Discussion on the relationship between possession of a JFA license and subjective evaluation of the soccer game video

Next, the effects of content knowledge on evaluation of the soccer game video were examined.

The results of the analysis indicate that the PE
teachers with a JFA license paid utmost attention to "Enjoying the game" and "Awareness of attacking goal," while the teachers without a JFA license paid utmost attention to "Motivation for game" and "Running into space." Thus, the viewpoint extracted from this analysis is different from the one extracted from the analysis based on teaching years. It can be speculated that this difference reflects the effect of the JFA coaching training system.

In fact, regardless of the possession of a JFA license, all PE teachers paid great attention to affective goals such as enjoyment and motivation. It can be said, however, that PE teachers with a JFA license paid attention to affective goals with a clearer focus on the tasks that should be preferentially handled during the game.

Goals of PE lessons include not only the teaching of physical activities to students but also the cultivation of student affections, awareness, and sociality. Affective development has been regarded as particularly important from the perspective of nurturing the habit of life-long participation in sports. On the other hand, it has been pointed out that it is necessary to establish specific learning tasks in order to achieve affective development (Crum, 1992). These tasks correspond to the tasks that are to be performed in physical education. In terms of the invasion games, the tasks that should be performed in lessons are considered to be keeping possession of the ball, invasion into space where scoring is easier, and scoring (Spackman, 1983). This idea is reflected in the JFA coaching training system.

According to the JFA, the function of the soccer coach is to "convey the charm of soccer to people through the essence of soccer; that is, scoring goals, preventing the goal, or winning the ball" (JFA, p.10). This implies that score-conscious offence and defense are central to soccer lessons.

The results of this analysis indicate that PE teachers with a JFA license watched the soccer game video based on the ideas which the JFA has advocated in terms of motor domain and affective domain, while PE teachers without a JFA license watched the game with a focus not on the tasks to be handled in PE classes but on the method of solving the tasks.

6.3. Discussion on the relationship between possession of a JFA license and teaching years

From above analysis, it was suggested that the ability to observe soccer game video gradually improves with the length of years in giving soccer lessons. Especially it was suggested that a certain length of teaching years is required to develop the ability to observe games with a focus on the tasks that should be handled in the games. This corresponds to Houssner’s comment (1991, 1993) that knowledge is structured on the basis of teaching experience and that experience allows one to construct knowledge. Meanwhile, the question of why the respective views of teachers regarding the affective aspects of the game were not reflected in the results of the analysis of teaching years should be addressed. PE teachers with a JFA license tended to watch the game with a focus on the affective goals of the lesson. The results indicate that the focus of observation continues to be limited to performance in a game as teaching experience increases and that the teachers rarely watch games from the perspective of multiple lesson goals, particularly affective.

The difference of perspective related to possession of a JFA license may indicate that an increase in teaching years is not the sole contributor to development of the ability to watch games based on the goals of PE lessons. It can be suggested that category of teaching experience and possession of a JFA license independently affect the formation of perspective for watching the soccer game. It is suggested that the observational perspective based on the goals of PE lessons can be utilized only with the development of adequate data and training based on such data.

7. Conclusion

In this study, the effect of sports teaching experience (teaching years and content knowledge) on subjective evaluation of a soccer game video were investigated. The results have revealed the followings:

- The difference in observational capacity between the PE teachers with long and short teaching years on soccer can be discriminated from viewpoints concerning the tasks, such as using space, which should be handled during the game.
- The difference in observational capacity between PE teachers with and without content knowledge (possession of a JFA license) can be discriminated from viewpoints concerning affective goals and the tasks to be handled preferentially during the game.
In this way, the differences in observational perspective caused by teaching years and content knowledge have been quantitatively confirmed.

It is hoped that these results will be utilized in the formation of evaluation indexes for game evaluation ability and for training in observation capacity based on the tasks that should be handled during the game. For example, game observation capacity can be evaluated based on the evaluation indexes that have been established. On the basis of the results of this evaluation, feedback for observational perspectives which support an understanding of the game can be provided. Based on this, furthermore, a support system for the Physical Education Teacher Education can be developed. For PE teachers as the assumed users, the system can be designed in this way: if a user inputs certain evaluation data, which is similar to the data used in this study, after watching a sports video displayed on the screen of the system, the user’s observational viewpoint is automatically analyzed, and specific data concerning the method of education that is useful for the user is output.

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References


DSB (1979) Sportlehrerausbildung Analyse und Reform. 4. unverä. Aful.


JFA. Textbook for coaching soccer. JFA:Tokyo


Morisaki, N., et al.

Champaign
NASPE (1995) National Standards for Beginning Physical Education Teacher. NASPE. USA
Okade Y. (1998) Tactics, operation and strategy in the Japanese Course of Study after the World War II. Physical Education. 46(8):54-56

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