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Correlation Analysis between Impressions of Soccer School and Moving Speed in Elementary School Children

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Abstract

In sports, the importance of enjoying exercise and interaction with others has been suggested, and it is an important question as to what kind of activities lead to enjoyment. The results of the questionnaire survey of soccer school students indicated that "game-style practice is the most enjoyable," and that "enjoyment" was related to "lots of running" and "lots of involvement with the ball." However, it was not clear how much they actually ran. Therefore, in this study, in order to analyze the relationship between the results of the questionnaire survey and actual movement, we analyzed the running style in game-style practice using GPS (Global Positioning System) and examined the correlation with the questionnaire results. The results showed that feeling that they "ran well" did not correlate well with actual distance or speed. On the other hand, moving at low speed are related to having fun and being able to shoot and pass the ball a lot. This result contradicts the survey results, which showed that students who responded that they "enjoyed" also responded that they "ran a lot," making it clear that the results of the survey cannot be taken for granted.

Keywords: soccer, GPS, speed, correlation analysis.

1 Introduction

It has been suggested that participating in physical activity and interacting with others are important in sports, but it has not been specified what types of activities lead to enjoyment. Tanioka et al. [1] therefore conducted an online questionnaire survey among elementary school students attending the Tokushima Vortis Soccer School [2] (hereafter referred to as the school) to determine how they felt while attending the school, whether they enjoyed the school's activities, and what activities contributed to their enjoyment of the school. According to the survey results, the most popular response was that the most enjoyable part of the soccer school was the game-style practice. The game-style used at the school is the small-sided games [3], which is also referred to in the Japan Football Association (JFA) small-sided games guidelines [4] developed by the JFA Technical Committee, and is "a child-centered" "enjoy" for each age group. It can be deduced that the content of the practice is "child-centered" and considered the best way for each age group to enjoy soccer.

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Correlations were also made between the following questions: “Did you enjoy the soccer?” “Did you do a lot of running?” “Did you do shooting or passing a lot?” “Did you do a lot of dribbling?” “Do you have pain?” and “Were you tired?” However, it is unclear how much the students ran a lot in the game-style exercises they indicated they preferred. Therefore, an additional experiment using global positioning system (GPS) and questionnaires was carried out in this study to clarify the relationship between the questionnaire results and actual movements. In Section 2.2, we will discuss related research on sports data analysis using questionnaires and GPS. Section 3 also describes the questionnaire method as well as the GPS experimental method. Section 4 contains a tabulation of the experimental results and the results of the correlation analysis. In Section 4.3, we examine in depth the relationship between the moving speed and the questionnaire items using the location information obtained from the GPS data.

2 Purpose of this research

This study aims to determine the relationship between the school students who participated in a soccer school’s questionnaire responses and their actual movements. First, the soccer school that will be the focus of the experiment was described. The second section describes related researches.

2.1 Teaching policy of Tokushima Vortis school

The following is the teaching policy at Tokushima Vortis Soccer School [2]. Tokushima Vortis Soccer School emphasizes greetings, rules, manners, cooperation, gratitude, tidiness, discipline, and never giving up to teach human development. To achieve this, the coaches use their attitude and words to emphasize the importance of becoming a person who is supported by everyone, helping others, and having a considerate heart in the classroom. The school also tries providing instruction that uses different methods for different situations, such as scolding, praising, acknowledging, and making the students think without talking so that the students can think about what they must do right away, recognize attempts to challenge themselves, and identify what the students are trying to do and work to develop their strengths. The school will also encourage the students to hope their skills.

In the technical aspects of soccer, the school teaches the essence of soccer, “attack = scoring goals” and “defense = taking the ball and defending the goal,” based on each student’s developmental stage and individual differences. To achieve these objectives, the school will help students develop a sense of accomplishment and a feel for the ball by having them set and achieve goals throughout the practice session. Furthermore, the school communicates with parents and guardians to determine what each student requires and what the school wishes for the students to learn. The school will also teach students to be aware of their surroundings and to play in the opposite direction of their opponents.

2.2 Related researches

Elbe et al. [5] showed that exercise enjoyment is important for young children aged 8 – 10 years. Uchida et al.’s study [6] in the field of early childhood education suggested that a motor play instructional program with an awareness of intrinsic motivation promotes the development of motor skills. Smith et al. [7] stated that there is potential for understanding

of social relationships and motivational processes in youth sports using questionnaire. Bengoechea et al. [8] discussed a potential intervention for youth sports leaders regarding the enjoyment/joy of sports. Umezaki [9] discusses the importance of individual motivation in sports activities based on life stage, but there is still much work to be done.

Scharfen et al. [10] discovered a positive correlation between cumulative cognitive test scores and cumulative motor test scores in youth soccer players aged 11 – 13 years. Fumoto et al. [11] showed that for U-12 generation, ball juggling skills are not an indicator of a good athlete. Goto et al.'s research [12] showed that there is a high correlation between tactic awareness and game enjoyment among fourth–sixth graders. Acccording to the findings of Goto et al.'s study [13] of junior high school players, the technique of juggling by instep is a game-enjoyable skill.

Researches utilizing GPS devices include the following. Sakamoto et al. [14] used GPS devices to assess performance in elementary school and younger children. Yuda et al. [15] analyzed the fitness of youth-aged players. Kai et al. [16] investigated the link between training load and physical fitness in college-age soccer players. Nunes et al. [17] analyzed the effects of small-sided games in three age groups (U-11, U-15, and U-23) and discovered that the intensity of long distance walking varied by age group.

3 Research method

participants in this experiment will be asked to wear bibs with GPS devices attached and complete a questionnaire a the end of the school day.

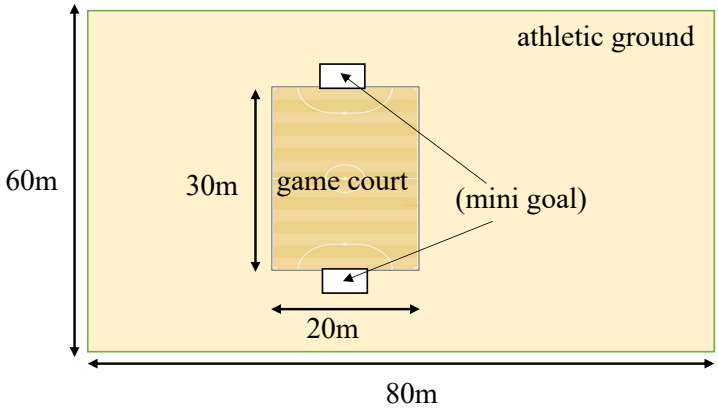

Figure 1: Athletic ground size for practices and game court size for small-sided game (Note: adapted from Reference [1])

3.1 Data collection

We conducted a voluntary questionnaire survey of Tokushima Vortis Soccer School students (20 students per class; total capacity of 180 students) from December 2021 to April 2022. 11 students took part in the additional experiment in third–fourth grade classes on March 15, 2022, and March 22, 2022. The survey results were reviewed, and correlations between the survey items were examined. All students who took part wore GPS-enabled bibs.

3.2 Questionnaire

As variables, the questionnaire items a 5-point Likert scale (very much agree, agree, don't know, not much agree, and not at all agree), and included "Did you enjoy school? (1. enjoy?)," "Did you get tired? (2. tired?)," "Did you have any pain? (3. pain?)," "Did you do shooting and passing a lot? (4. shoot and pass?)," "Did you do a lot of dribbling? (5. dribble?)," "Did you do a lot of running? (6. run and sprint?)" were graded on 5-point interval scale. Furthermore, the number of juggling (7. juggling count) was assessed using self-report.

3.3 GPS monitoring

Wearable devices equipped with a GPS and a statistical analysis system were used, accodeing to Knows [1]. This system can obtain the position, speed, and acceleration of school students every second, as well as covered the distance, number of steps taken, and stride length during the measurement period. Figure 1 shows the size of the soccer court used in the game. The tabulation took approximately 40 minutes (18:50–19:30), with the game-style practice held during the latter half of the school day (19:30–20:30). Since the event was held in the evening, battery-powered LED lighting from Ritelite (Systems) Ltd. [2] was used.

4 Experimental results

Table 1 shows the experiment's findings, including questionnaire responses and GPS data. Following that, we examine correlations using statistical data from the survey information and GPS data.

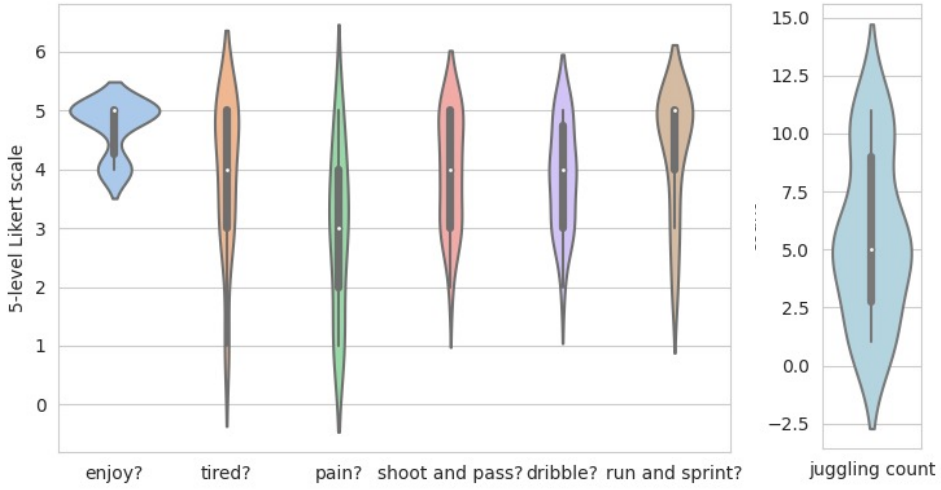

Figure 2: Violin graphs showing the distribution of questionnaire results on a 5-level Likert scale and *juggling count*

[1] SOLTILO Knows Co., Ltd., `https://know-s.com/`.
[2] Ritelite (Systems) Ltd. `https://riteliteportablelighting.co.uk/`.

Table 1: Questionnaire results in 5-level Likert scale and *juggling count*

ID	enjoy?	tired?	pain?	shoot and pass?	dribble?	run and sprint?	juggling count	Distance	Step	Stride	*SPD_AV*	*SPD_Z1* (%)	*SPD_Z2* (%)	*SPD_Z3* (%)	*SPD_Z4* (%)	*FRQ_Z1* (%)	*FRQ_Z2* (%)	*FRQ_Z3* (%)	*FRQ_Z4* (%)
0	5	5	5	5	4	5	10	3038.65	4686	0.65	5.05	39.42	44.17	16.03	0.03	9.32	13.53	5.74	0.03
1	5	4	4	5	5	5	5	2101.34	3514	0.6	4.81	49.91	37.03	12.40	0.09	7.69	10.59	3.83	0.09
2	5	5	4	4	5	5	6	2177.62	4113	0.53	4.31	43.66	44.74	11.10	0.00	11.38	14.35	4.11	0.00
3	5	5	5	5	5	5	5	2358.17	4225	0.56	4.39	46.00	41.66	11.90	0.00	10.00	13.93	4.84	0.00
4	5	1	1	5	4	5	1	2175.46	4268	0.51	3.77	44.28	47.17	8.01	0.00	12.29	14.41	2.76	0.00
5	5	5	1	5	5	5	5	2326.25	3988	0.58	4.38	43.55	44.66	11.23	0.03	9.96	13.50	4.84	0.03
6	5	5	4	3	3	5	1	2444.8	4197	0.58	4.38	46.84	42.06	10.66	0.00	10.28	13.47	4.21	0.00
7	5	5	2	5	3	5	1	2866.67	4574	0.63	5.28	45.79	36.15	17.52	0.00	8.19	13.06	6.42	0.00
8	5	4	4	4	5	5	10	908.79	2004	0.45	3.94	71.80	24.21	3.96	0.00	8.17	9.44	1.84	0.00
9	4	5	3	3	4	5	5	2394.13	3960	0.6	5	47.01	38.25	14.26	0.00	11.57	15.30	5.12	0.00
10	5	5	3	3	3	5	5	2383.84	4200	0.57	4.64	43.80	44.15	11.51	0.00	9.55	12.62	3.83	0.00
11	5	1	1	5	4	5	1	3025.13	5014	0.6	4.74	43.49	40.85	15.60	0.03	10.03	14.35	6.23	0.03
12	5	5	1	4	3	5	6	1938.77	4156	0.47	3.45	46.84	47.44	5.42	0.00	11.44	13.24	2.70	0.00
13	5	4	3	5	5	5	2	2686.55	4623	0.58	4.08	38.45	51.72	9.58	0.00	11.41	14.82	4.55	0.00
14	4	3	3	3	4	4	10	3146.88	5292	0.59	4.4	35.87	50.66	13.17	0.00	11.08	15.09	5.57	0.00
15	4	5	3	2	2	4	5	2350.31	4105	0.57	4.22	46.00	43.52	10.12	0.03	11.08	14.11	4.46	0.03
16	5	4	3	3	4	4	2	2500.38	4606	0.54	4.11	39.48	50.63	9.77	0.00	13.99	17.05	4.94	0.00
17	4	3	5	4	4	3	5	2226.24	4351	0.51	4.09	51.35	38.74	9.65	0.00	12.16	15.28	4.43	0.00
18	4	3	2	3	3	3	11	2116.3	4494	0.47	3.25	45.99	49.57	4.32	0.00	13.02	14.82	2.37	0.00
19	5	3	3	4	4	3	11	1048.8	2268	0.46	3.75	69.30	25.91	4.76	0.00	8.89	10.45	2.19	0.00
20	5	3	4	4	3	2	5	2853.31	4838	0.59	4.58	40.99	45.84	12.99	0.00	10.60	14.64	5.27	0.00
21	4	3	1	3	3	2	10	2734.79	4589	0.6	4.36	41.06	46.36	12.28	0.00	11.83	16.05	6.05	0.00
count	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
mean	4.727	3.909	2.955	3.955	3.864	4.318	5.545	2354.690	4184.773	0.556	4.317	46.40	42.52	10.74	0.01	10.63	13.82	4.38	0.01
std	0.456	1.269	1.362	0.95	0.889	1.041	3.447	556.894	768.10	0.056	0.505	8.65	7.14	3.72	0.02	1.61	1.81	1.33	0.02
min	4	1	1	2	2	2	1	908.79	2004	0.45	3.25	35.87	24.21	3.96	0.00	7.69	9.44	1.84	0.00
25%	4.25	3	2	3	3	4	2.75	2176.000	4107.00	0.515	4.083	41.67	39.26	9.60	0.00	9.65	13.30	3.83	0.00
50%	5	4	3	4	4	5	5	2371.005	4246.5	0.575	4.370	45.04	44.16	11.16	0.00	10.84	14.23	4.51	0.00
75%	5	5	4	5	4.75	5	9	2722.73	4601.75	0.598	4.625	46.84	46.96	12.84	0.00	11.54	14.82	5.23	0.00
max	5	5	5	5	5	5	11	3146.88	5292	0.65	5.28	71.80	51.72	17.52	0.09	13.99	17.05	6.42	0.09

4.1 Survey results

Participants in this experiment were asked to wear bibs with GPS devices attached and complete a questionnaire after school. The results of the questionnaire are shown in Figure 2. The distribution of the 5-level Likert scale in the survey results shows relatively high ratings for "enjoy?" "shoot and pass?" "dribble?" and "run and sprint?" and relatively low ratings for "tired?" and "pain?"

- Most students enjoyed their time at school.
- Some students were exhausted.
- Several students experienced physical discomfort.
- Some students had many shoots and passes.
- Some students dribbled a lot.
- A lot of students ran and sprinted.
- The juggling times were evenly distributed $[1, 11]$.

Table 1 shows the GPS monitoring results in conjunction with the survey results. IDs 0 through 10 had their results compiled on March 15, 2022, and IDs 11 through 21 had their results compiled on March 22, 2022. From the GPS data, the average distance moved approximately $2,354$km ($SD = 556.894$), the average number of steps was approximately $4,184$ steps ($SD = 768.10$), the average step length was approximately 0.556m ($SD = 0.056$), and the average moving speed was approximately 4.317km/h ($SD = 0.505$). The *SPD_Z*1 represented the percentage of time spent moving between 0 and 2km/h during the measurement time, *SPD_Z*2 represented the percentage of time between 2 and 6km/h, *SPD_Z*3 represented the percentage of time between 6 and 18km/h, and *SPD_Z*4 represented the percentage of time spent moving at 18km/h or more; and FRQ_Z1 represented the frequency of movement between 0 and 2km/h within the measurement time, FRQ_Z2 represented the frequency of movement between 2 and 6km/h, FRQ_Z3 represented the frequency of movement between 6 and 18km/h, and FRQ_Z4 represented the frequency of movement over 18km/h.

Table 2: Correlation coefficients ρ between survey items

	1	2	3	4	5	6	7
1 enjoy?	–						
2 tired?	0.120	–					
3 pain?	0.056	0.356	–				
4 shoot and pass?	0.630 **	−0.162	−0.002	–			
5 dribble?	0.374 *	−0.012	0.270	0.613 **	–		
6 run and sprint?	0.492 **	0.383 *	0.011	0.400 *	0.409 *	–	
7 juggling count	−0.386 *	0.023	0.148	−0.268	0.010	−0.435 *	–

Note: * $p < 0.05$, ** $p < 0.01$, $n = 20$ (one-tailed).

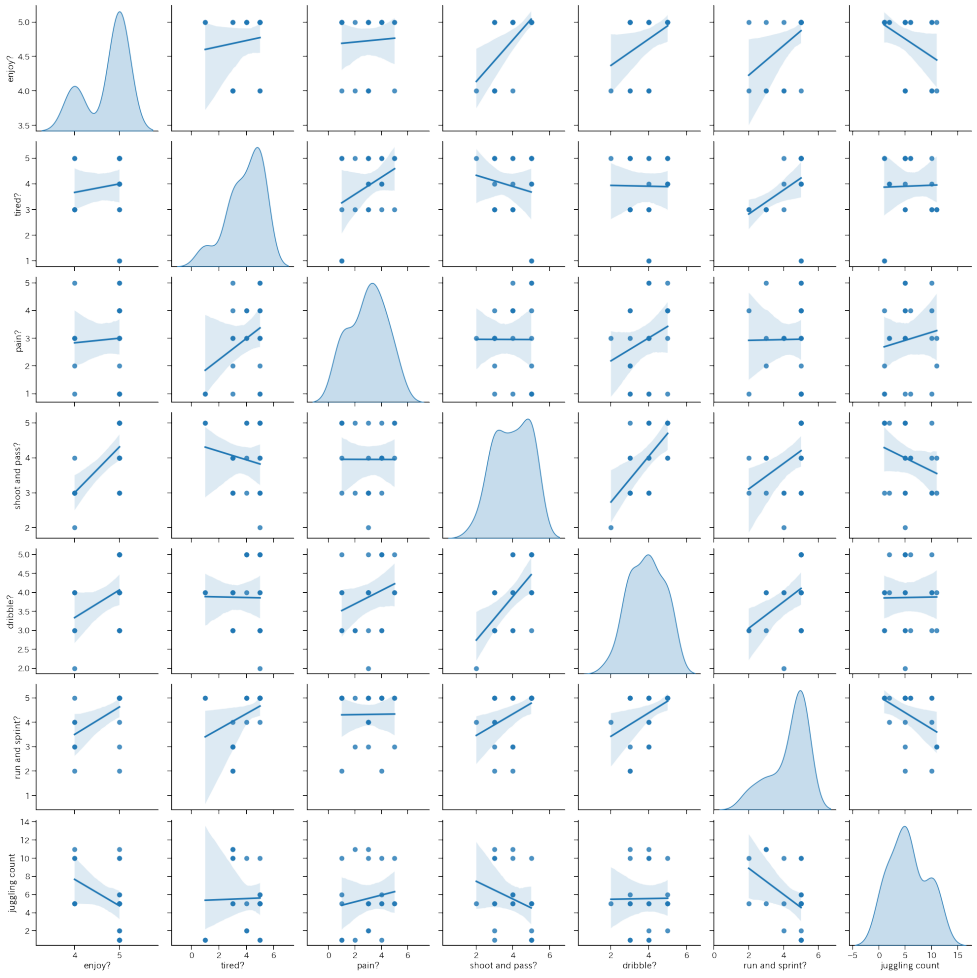

Figure 3: Pair plots for correlations regarding survey results

4.2 Correlation analysis

The correlations between each survey item are examined using Pearson's correlation coefficient. Table 2 shows the results of the correlation analysis based on the questionnaire responses. It can be seen from the correlations ($p < 0.05$), we see that "run and sprint?" is positively correlated with "enjoy?" and conversely, "juggling count" is inversely related to "enjoy?" Furthermore, "run and sprint?" is positively related to "shoot and pass?" as well as "dribble?" Figure 3 shows pair plots for correlations regarding survey results, and each univariate distribution plot is drawn on a diagonal line and represents the marginal distribution of the data in each column. Based on the foregoing, we can conclude that the trend was consistent with the previous study [1]. Table 3 shows a slight correlation between the questionnaire items and the distance moved (Distance), the number of steps (Steps), the stride (Stride), and the average speed of movement (*SPD_AV*), as well as a slight correlation between the "juggling count" and the distance, number of steps, and stride (*SPD_AV*) as well as the number of steps and stride length. A negative correlation was also found between "pain?" and average movement speed, but no other obvious correlation was found.

Table 3: Correlation coefficients ρ between survey items and GPS data

	Distance	Step	Stride	*SPD_AV*
1 Enjoy?	0.000	−0.122	0.145	0.280
2 Tired?	0.076	0.061	0.062	0.241
3 Pain?	0.130	0.276	−0.225	−0.300
4 Shoot and pass?	0.251	0.149	0.290	0.237
5 Dribble?	0.090	0.023	0.075	0.161
6 Run and sprint?	0.135	0.077	0.150	0.212
7 Juggling count	0.331	0.300	0.309	0.249

4.3 Analysis of moving speed

The statistical information derived from the GPS data showed no relationship with the survey results. Therefore, we will use statistical information on their movement speed based on location to analyze how students move in game-style practice. The percentage of cumulative time for each section of the moving speed is used in this experiment. Formula (1) is used to calculate the percentage of cumulative time, where the numerical values in $Z1$ through $Z4$ are represented by replacing Zx.

$$SPG\_Zx = \frac{\sum T_{Zx}}{D}, \tag{1}$$

here, T_{Zx} is the cumulative time for each section Zx of the moving speed. And D is the observation period (s). Table 4 shows a slight correlation between "shoot and pass?" and *SPD_Z*4, a slightly positive correlation between "juggling count" and *SPD_Z*1, and a slightly negative correlation between "juggling count" and *SPD_Z*3. $Z1$, and a slightly negative correlation with *SPD_Z*3. Therefore, we considered another indicator. Each sec-

Table 4: Correlation coefficients ρ between survey items and time percentages by moving speed

	*SPD_Z*1	*SPD_Z*2	*SPD_Z*3	*SPD_Z*4
1 Enjoy?	0.134	−0.175	0.018	0.137
2 Tired?	−0.027	−0.049	0.133	0.039
3 Pain?	0.173	−0.260	0.095	0.070
4 Shoot and pass?	0.030	−0.160	0.226	0.308
5 Dribble?	0.181	−0.203	−0.037	0.229
6 Run and sprint?	−0.025	−0.077	0.181	0.241
7 Juggling count	0.337	−0.213	−0.356	−0.049

tion of the moving speed's frequency rate is used. The calculation of the frequency rate is given by equation 2, where the numbers $Z1$ to $Z4$ are expressed by replacing Zx.

$$FRQ\_Zx = \frac{\sum N_{Zx}}{D}, \tag{2}$$

here, N_{Zx} is frequency for each section Zx of the moving speed. And D is the observation period (s). Table 5 shows a negative correlation between "enjoy" and FRQ_Z1 and FRQ_Z2, a negative correlation between "shoot and pass?" and FRQ_Z1 and FRQ_Z2, and a slightly positive correlation is observed between "run and sprint? There is also a slightly negative correlation between "run and sprint?" and FRQ_Z1 and FRQ_Z2. For "juggling count", there is a slightly negative correlation with FRQ_Z3.

Table 5: Correlation coefficients ρ between survey items and frequency percentages by moving speed

	*FRQ_Z*1	*FRQ_Z*2	*FRQ_Z*3	*FRQ_Z*4
1 Enjoy?	−0.450 *	−0.446 *	−0.137	0.137
2 Tired?	−0.245	−0.163	0.061	0.039
3 Pain?	−0.230	−0.178	−0.007	0.070
4 Shoot and pass?	−0.434 *	−0.294	0.097	0.308
5 Dribble?	−0.218	−0.237	−0.106	0.229
6 Run and sprint?	−0.343	−0.306	−0.043	0.241
7 Juggling count	−0.091	−0.251	−0.304	−0.049

Note: * $p < 0.05$, $n = 20$ (one-tailed).

5 Discussion

The correlation analysis of the survey results shows that school students who responded that they enjoyed it very much, ran a lot, and were very involved with the ball. It is clear that students who juggle more frequently did not run as much and did not participate as actively. Statistics such as distance traveled, number of steps, stride length, and average travel speed based on GPS data showed no correlation with the survey results, but when the range of travel speeds was limited and the frequency of travel at each speed was examined, the correlation became clear. The results showed that the less frequently respondents moved at slower speeds, the more they indicated that they enjoyed and shot and passed a lot. The frequency of slow movement can be interpreted as the number of times the student stopped or walked. In other words, fewer breaks are related to the enjoyment of game-style practice and many shots and passes made.

6 Conclusion

The results of a voluntary questionnaire given to participating school students who were wearing bibs with GPS devices attached were tabulated, and the correlation between the questionnaire results and GPS data was examined. In conclusion, we can say the following.

1. Students who participated in the soccer school, enjoyed the game (match).
2. Students who ran well, also dribbled, shot, and passed well.
3. Students who dribbled a lot, also shot and passed a lot.
4. Students who were good at juggling, did not enjoy soccer class.
5. Students who enjoyed playing soccer, moved slowly less often.
6. Students who shot and passed well, moved slowly less often.

According to the findings of the correlation analysis, school students who enjoyed the practice ran more and were more involved with the ball. On the other hand, students with higher juggling skills were found to enjoy it less. The GPS data also showed that students who enjoyed themselves ran at low speeds less frequently, and students who shot and passed more frequently ran at low speeds less frequently. Running at low speeds less frequently means less stopping of the feet. This implies that school children who enjoy practicing and shooting and passing a lot do not stop on their feet. On the other hand, students who responded

that they "ran well" did not correlate with the distance they traveled or their average travel speed. In other words, feeling that they "ran well" did not correlate well with actual distance or speed. This result contradicts the survey results, which showed that students who responded that they "enjoyed" also responded that they "ran a lot," making it clear that the results of the survey cannot be taken for granted. However, since the relationships discussed in this study are correlational and cannot be shown to be causal, it is unclear whether they are enjoyable and do not stop, whether they are enjoyable because they do not stop, or whether they do not stop because they shoot and pass a lot, or because they shoot and pass a lot and do not stop. In the future, we hope collect more questionnaires and GPS data on people of various ages and practices to improve the study's reliability while clarifying causal relationships.

Acknowledgments

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