Achievement Probability and Development Stage of Fundamental Movement-control Skills and Gymnastic Skills in Japanese Youth


*Faculty of Education and Regional Sciences, Tottori University
4-101, Koyama Minami, Tottori, 680-8551 Japan
E-mail: kokudo@fed.tottori-u.ac.jp
**Institute of Health and Sport Sciences, University of Tsukuba
***Institute of Human Living Science, Otsuwa Women’s University
****Hokkaido University of Education, Kushiro Campus
*****Department of Physical Education, International Budo University
******Department of Sports and Health, Japan Women’s College of Physical Education
*******Faculty of Education, Meiji University
********Physical Education Sports Science Research Center, Tamagawa University
*********School of Sports and Health, Junteido University
**********Graduate School of Arts and Sciences, University of Tokyo
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The purpose of this study was to describe the development state of motor skills by examining the achievement probabilities of the skills concerning fundamental movement-control and gymnastics that can be evaluated qualitatively. The subjects were 5,637 males and 5,064 females in elementary, junior high, and high schools. A questionnaire survey was conducted on 31 items concerning fundamental movement-control skills and gymnastic skills. The achievement probabilities and development stages of respective motor skills were reviewed by studying the obtained data. It has been found out that many of children’s motor skills develop significantly while they are in elementary school. Almost all the children learn some of the fundamental movement control skills in lower grades. However, there are some among items of floor exercise and vaulting box almost all the children cannot perform, although the subject are included in the curriculum to be taught. Children need longer period of time to obtain the skill for those assignments that require strength and speed, and accordingly longer instruction period is desirable. Many of the assignments are taught after the development stage, which suggests needs for appropriate instruction periods suitable for development stages.

Keywords: achievement probability, motor development, fundamental movement-control skill, gymnastic skill, development stage

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1. Introduction

Physical capabilities and strength are often measured in terms of time, distance, and number of times. However, in most of the scenes of physical exercises, qualitative either/or evaluation of "success or failure," "good at or poor at," "can or cannot," "scored or not scored" is used.

New National Curriculum Standards was announced in 1998 and after 2 years of transition measures, which started in 2000, the study under the new guidelines has been implemented, starting from last school year [Min-

istry of Education, Science, Sports and Culture, (1999a); (1999b); (1999c)]. The absolute evaluation system becomes important for measuring fruition level of the benchmarks mentioned in the new standards. It is necessary to identify the degree of achievement of respective assignments in order to make absolute evaluation.

The guidelines specify particulars of assignments and allocation grades. Children and students engage in various exercises in their daily life, including participation in sports clubs. Their experience in the wide variety of exercises affects their physical capabilities.
The understanding of the state of motor skills of today's children and students will be the basis of tracking changes and evaluating that of future children and students.

Although studies and materials concerning the developmental characteristics of measured values of physical strength and abilities [Matsuura, Y. (1982); Malina, RM. and Bouchard, C. (1991); Society for the study of physical fitness standard value, Tokyo Metropolitan University (2000)] and studies and materials concerning the mechanism of childhood motor development [Kim, S. and Matsuura, Y. (1988); Payne, VG, and Isaacs, LD (1988)] can be found, there are few reports on the degree of achievements of skills for exercises taught in school by respective grades. If the characteristics of changes are investigated, we will be able to evaluate not only the degree of achievement but also the appropriateness of assignments and the suitable grade to teach particular assignment.

The purpose of this study is to describe the development state of motor skills based upon the degree of achievement by choosing items of fundamental movement-control exercises and apparatus gymnastics, which can be evaluated by binary scale, found in the Curriculum Standards for elementary and junior high schools.

2. Methods

Subjects were 1,989 boys and 2,022 girls elementary school children, 2,022 boys and 1,812 girls junior high school students, and 1,626 boys and 1,230 girls high school students, or 10,710 in total of 11 prefectures of Japan (Table 1). We conducted a questionnaire concerning motor skills. The questionnaire focused on exercises using vehicles and jump rope exercises that belong to fundamental movement-control domain and floor, horizontal bar, and vaulting box exercises that belong to apparatus gymnastics, totaling 31 items, which are included in or related to subjects of instruction for elementary, junior high, and high schools in the Curriculum Standards [Ministry of Education, Science, Sports and Culture (1989a); (1989b); (1989c); (1999a); (1999b); (1999c)]. Three options were provided as responses to questions, namely, "I can do it well," "I can do it," and "I can’t do it." In order that the respondent would understand fully the details of the assignment in question, respective assignments were illustrated for confirmation as shown in Fig.1.

The survey was conducted between April and July 2000 when Japan Fitness Test was carried out in schools.

The degrees of achievement were calculated concerning respective assignments by sex and by age. The Delphi Method was used to the graphs showing changes in the achievement probability of exercise assignments, to find out:

Start of the development stage: the grade when the achievement probability starts changing;

End of the development stage: the grade when improvement of the achievement probability stopped or the slope changed.

The period in between the above two stages was named development stage, the period before the start of the development stage was named predevelopment stage, and the period after the end of the development stage was named postdevelopment stage. The regression line of postdevelopment stage was calculated and the estimated achievement probability by the regression line at the 3rd grade of high school was defined as the eventual achievement probability. The regression line of the development stage was calculated. The study periods indicated in the Curriculum Standards were shown on the graph showing the development in order to compare them with the development stages identified in the above analysis.

3. Results

Figure 2 shows changes in the achievement probability of jump rope skills. No predevelopment stage was seen for both boys and girls concerning the jump rope assignments. Quite a lot of 1st grade boys and girls could do basic bounce, and we were unable to identify the development stage. As for other assign-
ments of jump rope, they acquired skills when they were 1st to 4th grades. As for basic bounce, backward jump, and cross jump, children’s skill developed highly from 1st grade to 5th or 6th grade. Concerning double jump, the achievement probability kept increasing even in the post-development stage. The eventual achievement probability reached respectively to over 90% concerning basic bounce, backward, and cross jumps, but that of double jump was 83% for both boys and girls. The proficient achievement probability was 50.9% for basic bounce for boys and 67.5% for girls. The probability was lower for backward jump, which further lowered for cross jump and still further lowered for double jump. The eventual probability of double jump skill was only about 33% for both boys and girls.

**Figure 3** shows the achievement probability of vehicle-related skills. Over 80% of the first graders and more than 95% of the 3rd graders could ride a bicycle. The proficient achievement probability was about 30% for the 1st graders, and it kept improving and about 70% of the 5th and 6th graders answered, "I can do it well." As for stilts, the development stage was between 1st and 5th grades, when about 40% acquired the skill. The proficient achievement probability, however, did not show significant difference even when the grade went up. As for monocyte, the eventual achievement probability was 24.7% for boys and 63.5% for girls that is, the probability of girls showed much higher than that of boys. The development stage was between 1st and 6th grades for boys and up until 4th or 5th.
Fig. 2. Achievement probability of jump rope.

Value in the grade were estimated as eventual achievement probability of 3rd grade students in high school.
Equations were estimated developing line during the development stage.
In the equation, p means percentage of the skill achievement, and g means grade, where 1st grade of junior high school was substituted as 7, and 3rd grade of high school was as 12.
Gradation on Standard learning grade means that the skill is appeared as related other motor skills or one of combination skills.

Fig. 3. Achievement probability of riding.

Numbers were estimated achievement probability of 3rd grade students in high school.
Equations were estimated developing line during the developmental period. In the equation, p means percentage of the skill achievement, and g means grade, where 1st grade of junior high school was substituted as 7, and 3rd grade of high school was as 12.
Gradation on Standard learning grade means that the skill is appeared as related other motor skills or one of combination skills.
grade for girls.

**Figure 4** is the changes in the achievement probability of floor exercise skills. The straddle front roll showed the highest eventual achievement probability, with 84.6% for boys and 89.9% for girls. Next in line for the higher eventual achievement probability was the handstand against the wall (81.2% of boys and 73.0% of girls), and then straddle back roll (76.5% for both boys and girls). The eventual achievement probabilities were about 50% for boys and 40% for girls concerning piked forward roll, piked backward roll, and cartwheel. Back roll extension, neck spring, and headspring showed respectively very low eventual achievement probability of 20 to 25% for boys and 3 to 9% for girls. The development stage started from 1st grade concerning handstand against the wall and cartwheel. All the other items did not show improvement of achievement probability in the 1st and 2nd grade, but a rapid improvement was identified after 3rd grade. The development stage for forward and backward roll was 3rd and 4th grade. For neck spring and headspring, the development stage was 1st and 2nd grades of junior high school as long as boys were concerned.

**Figure 5** shows the achievement probability of horizontal bar skills. The eventual achievement probability of back up to support for boys was 85.0% and 73.5% for girls. The probability was about 60% for hip circle forward, about 50% for half knee circle forward upward. The probability never reached 50% for hip circle backward and kip. The development stages for these skills were found to be in the 1st to 4th or 5th grades.

**Figure 6** is for the achievement probability of vaulting skills. The development stage for straddle started

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**Fig. 4. Achievement probability of floor exercise.**

Numbers were estimated achievement probability of 3rd grade students in high school.

Equations were estimated developing fine during the developmental period.

In the equation, p means percentage of the skill achievement, and g means grade, where 1st grade of junior high school was substituted as 7, and 3rd grade of high school was as 12.

Gradation on Standard learning grade means that the skill is appeared as related other motor skills or one of combination skills.
when or before the children were in 1st grade and ended when they were in the 4th grade. As for those who said "I can do it well," the development stage was a little longer and ended when they were in the 6th grade. The eventual achievement probability of skills exceeded 90% for both boys and girls. As for drive roll onto a platform, the achievement probability lowered when the children were in the 5th grade, but the development stage mostly continued until they were in the 6th grade. The probability kept improving to show the eventual achievement probability of 60% for both boys and girls. As to squat, the boys eventually showed the achievement probability of over 50%, but the development stage ended when the students were in the 1st grade of high school. As for the other exercise assignments, the patterns of change in the achievement probability were mostly similar for both boys and girls, and the eventual achievement probability was 30% for boys and below 10% for girls.

4. Discussion

The Curriculum Standards mentions basic bounce of jump rope as a skill for 1st to 4th graders and backward jump and cross jump as skills for 3rd to 4th graders. There is no mention of double jump, but it is assumable that they are supposed to be learned in 3rd and 4th grades from examples given concerning similar exercises. The development stage of jump rope skills except that of double jump are at an early date and the achievement probability tends to be higher. The number of those who say that they "can do it well" kept increasing until they are in 5th grade. Accordingly, we can say that the time of learning and the development stage coincide well. As for the backward jump and cross jump, many responded that they "can do it," when they were in the standard learning period or before that particular period. The children who say that they "can do it well" kept improving, just like the case of the basic bounce, until when they were in the 5th or 6th grade. Thus, it is suggested that the skills should be taught during the same period as the basic bounce is taught. We would like to add the fact that other skills than the basic bounce are taught usually to 1st and 2nd graders in elementary school. The development stage of double jump is when the kids are in
Fig. 6. Achievement probability of vaulting skills.

Numbers were estimated achievement probability of 3rd grade students in high school. Equations were estimated developing line during the developmental period.

In the equation, p means percentage of the skill achievement, and g means grade, where 1st grade of junior high school was substituted as 7, and 3rd grade of high school was as 12. Gradation on Standard learning grade means that the skill is appeared as related other motor skills or one of combination skills.
elementary school, but the improvement was seen even after they entered junior high school. The skill of jump rope involves the skill of turn the rope. Double jump requires, on top of the above skill, the ability to jump high in a short period of time, which suggests that higher responsiveness greatly affects the skill. This is probably why the achievement probability continued to increase concerning junior high school students.

As for the evaluation of bicycle riding, many of the children are able to ride a bicycle when they enter the elementary school. Accordingly, the identification of individual difference requires the skill evaluation such as "I can ride it well." The proficient achievement probability dropped for junior high school students. The same trend was found concerning skills for monocycle and straddle on vaults of girls. It is assumed that the reasons are actual decline of skill level or lower self-evaluation which come from less opportunities of performing the skills or of exertion their ability. The lower self-evaluation, especially, would include changing in the standard of self-evaluation which tends to be severer. The above needs further study gathering of preferential data.

It has been made clear that skills concerning stilts and monocycle develop significantly when the children are in 1st to 4th grades. The Curriculum Standards recommends instructions of these vehicles made for 3rd to 4th graders, but it seems to be desirable to include 1st and 2nd graders. Girls ride monocycle well with considerably higher achievement probability than boys. This is probably because of the difference in tastes, as girls are more willing to ride monocycle than boys.

Straddle front roll, straddle back roll, and handstand against the wall among the floor exercise items had achievement probabilities of nearly 80%, suggesting that the skills were relatively well acquired. However, the achievement probabilities were low for back roll extension, neck spring, and headspring, which are taught in junior high and high schools, and only one in five boys achieved the skills while almost no girl achieved them. Although assignments that require relatively higher skills are taught in upper grades of elementary schools and junior high schools, their development stage starts before the start of instruction. The timing of the start of the instruction tends to be delayed. Thus, there is a possibility that delayed start of the instruction is causing lower achievement probabilities of certain skills.

Questions concerning forward roll and backwards tucked roll among the floor exercise items were not included in the questionnaire for children in 5th grade and up, because the achievement probabilities were expected to be very high among the 4th graders and up. The achievement probability of forward roll of female 4th graders exceeded 85%, which can be regarded as very high. However, less than 50% of the boys in 4th grade said, "I can do it," concerning forward roll, and the similar percentage of both boys and girls in 4th grade answered the same way concerning backwards tucked roll, which requires further study. There are many floor exercise skills of which girls' development stage could not be identified since their achievement probability showed little or almost no improvement.

The almost all development stage of horizontal bar skills appeared before the standard instruction period. Even the development stage of kip, one of the most difficult subjects for students, is in elementary school, though kip is taught in junior high school. The development stage for girls was between the 1st grade and 5th or 6th grade based upon the both responses, "I can do it," and "I can do it well." The development stage of boys based upon the responses, "I can do it," was 1st grade to 4th or 5th grade, while the proficient development stages is not distinguished. The deference between boys and girls supposed to be from the inclination that girls tend to play horizontal bar skills like monocycle.

It is usually considered that hip circle forward is more difficult than hip circle backward. Accordingly, the Curriculum Standards states that hip circle forward are for the 4th graders, while hip circle backward are for 5th and 6th graders. However, in this study, the achievement probability of the hip circle forward was higher than that of the hip circle backward. Although the respective motions are clearly illustrated, the words "front roll" appears in the questionnaire, which might have mislead the respondent who, without checking the illustration, took it as the simple move of forward roll and down (front roll down). As we cannot deny the possibility of the misunderstanding on the part of respondents, further study is needed concerning the achievement probability of hip circle forward.

As for vaulting, the achievement probabilities were relatively high concerning straddle and drive roll onto a platform. The skills involved in the straddle are taught to the 3rd graders, and the actual instruction starts when they are in the 4th grade. The percentage of 3rd graders who had already acquired the skill exceeded 70%. It seems that they learned the skill while they were engaged in various exercises before the start of the instruction. However, although squat is for 4th graders and up, less than 60% could do the assignment. The drive roll onto a platform is specifically for the 4th graders. After the 5th grade, it is positioned as the fundamental movement before learning the skill of headspring. The drive roll onto a platform is something
that is learned early by children, and 60% boys and 50% girls of 5th grade could do it, while few could master the headspring. Taking the above into consideration, it is assumable that straddle and drive roll onto a platform are relatively easy skills while squat and headspring are significantly more difficult hard-to-achieve skills.

5. Conclusions

In this study, the developmental states of various motor skills were made clear by examining changes in achievement probabilities. Some of the items such as riding on bike and jump rope are easy for lower graders of elementary school and almost all the children acquire the required skills, while other items of gymnastic skills are difficult and almost all the children cannot learn how to do them although they are mentioned in the Curriculum Standards. The development stage tends to be longer for those skills that require not only the skillfulness but also the strength and speed, including double jump and handstand against the wall, and accordingly these should be taught for a longer period of time. There are many motor skills that develop during the elementary school years, but there are also many that are taught too late for the conspicuous development stage. It is necessary to make guidance during the suitable development stage.

The achievement probabilities used in this study were based upon the subjective evaluation made by the subjects, it is necessary to include increased objectivity in the future study. The achievement probability obtained in the study concerning the hip circle forward, among others, is rather unreliable, and as such, needs further review.

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References:
### Appendix: Achievement probability of basic movement-control skills and gymnastic skills

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